



100 Drink Data Collection

Data Collection

- Date: 2015-06-01 to 2015-06-11
- Tickets: AS-337
- Git Repo: data.mkone.co/var/git/science/vessyl/as-337.git
- Git Branch: master

Analysis

- Ticket: VA-128
- Git Repo: git.mkone.co:vessyl-algorithms/algorithms.git
- Git Branch: va-128

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Revision Control

Revision Number	Revision Date	Notes	Owner
1.0.0	2015-06-18	First draft release	Ehson Ghandehari

Introduction

The main purpose of beverage data collection is to create a breadth of data, which provides sufficient information for LED selection, to be utilized in Halo Engineering Validation Testing (EVT). A list of 500 (actual of 604 drinks) drinks has been prepared for wavelength selection purpose. However, as an initial step in data collection, a list of 100-drink (a subset of the 500-drink) was selected and tested. The 100-drink list consists of drinks representing all possible beverage categories (e.g. sports drinks, coffee, protein shakes), as tabulated in Appendix-E. The purpose was to ensure that our custom setup gave highly reliable data across a midsize cross-section of drinks.

Methods

Each liquid measurement is comprised of three trials (128 scans): 1) dark, 2) white, and 3) drink measurements. The inline-shutter was closed for dark measurements. The white measurement was the spectroscopic response of an empty, clean, and dry cuvette. The cuvette was cleaned by rinsing three times with distilled water, using a squirt bottle. The mirrored surface was contralateral to the fibre cable. Then it was rinsed once with isopropyl alcohol (IPA) and blown dried with pressurized air. The drink measurement is the spectroscopic response of the cuvette filled with the liquid. It should be noted that to reduce or eliminate the cuvette replacement error, the liquid was poured into the cuvette without replacing the cuvette.

According to previous studies (**VA-94**), a multiple integration time (IT) approach is advantageous for data analysis since it provides the possibility of partitioning the spectra into three or more sub-regions: UV, VIS, and NIR. Subsequently, each sub-region will be analyzed at its optimum IT. However, this approach necessitates at least one IT condition that produces a spectrum with no saturation (except the expected spikes caused by Deuterium light source around 645 nm). After using Deionized (DI) water, as a representation of transparent liquids, and heavy whipping cream, as a representation of fatty, light absorbing liquid, it was discovered that the IT of 30 ms produced a non-saturating signal all along the wavelengths. Therefore, it was decided to use three integration times of 30, 150, and 300 ms for transparent drinks, while using 30,150,300, and 600 ms for partially transparent, or opaque drinks (e.g. coffee, wine).

Setup

The setup used in the data collection was the red golden setup. The red golden setup consisted of a light source (Ocean Optics DH-2000; serial number 005400821), an optical fibre (Thorlabs; TP00932D05), an optical switch (Ocean Optics; INLINE-TTLS), a custom bifurcated fibre optic reflection probe (Thorlabs: RP20-Custom TP00994323; 6 fibres from the light source and 1 fibre to the spectrometer; the length from the light source to the cuvette or the spectrometer to the cuvette is 1 m each; the fibre used in this reflectance probe is a Thorlabs FG550UEC), a custom refurbished cuvette holder (Mark One Lifestyle Inc.), a quartz glass cuvette (Thorlabs; CV10Q3500F) with a custom aluminum mirrored surface, and a spectrometer (StellarNet; Silver Nova model, serial number 15040704). The light source was connected to the optical switch by a TP00932D05 fibre. The optical switch was connected to the front side of the cuvette holder by one leg (containing 6 fibre) of the reflection probe, and the other leg (containing 1 fibre) was connected to the spectrometer. The spectrometer was placed in an environmental chamber (Espec BTL-433) at a temperature of 20 C and 30% relative humidity. The spectrometer responded to a wavelength range from nm to nm with 3684 individual wavelengths. The GSCT software was build number 1.0.5532.17394. The computer running the tool was a Dell laptop running Windows 8.

Data Collection

The data (AS-337) were converted from XML format into tidy formatted comma separated values and all trials were concatenated together and compressed. This was done using a custom bash script that calls gsxmltidy.py and the output is concatenated. This output is then compressed using gzip. These compress files were read into R version 3.1.2 (2014-10-31). Within R a four stage cleaning process was performed. All stages are optional and can be performed in any order. They include a conversion phase where the data is converted into the correct data type. This phase is often performed, in part, during the read operation. The transform phase is used to manipulate the values of the data and correct any errors. During the filtering phase, unneeded or erroneous data is removed from the data set. In the final phase the data is transformed into tidy format, if required.

After the cleaning process, the data is run through a series of checks. These checks are independent of the cleaning phase and they test the quality of the data and assumptions that are being made. These would include, but not limited to, checks to see if the data is the correct data type, if there are missing values, the correct number of levels exist in a factor, values are in range and to make sure that all data is present. The light source produces several very large spikes in the spectrometer data. This causes saturation in some wavelengths and bleeds over into the adjacent wavelengths. Therefore, if the reflectance data was clipped, reflectance measures greater than 65530 in any trial it was removed for all trials collected by a given operator. To remove the bleed over, wavelengths that were +/- 1 nm an either side were also removed. The GSCT AS-337 data were loaded, cleaned and checked.

Data Analysis

The data analysis consists of presenting the drink, white, dark, and normalized (i.e. transreflectivity percentage) for at least two trials, at all IT conditions. Also the average transreflectivity of trials (along all wavelengths) was compared. The **Pass** criterion was that the mean of transreflectance (across all wavelengths) for each normalized trial should be within 1% of the lowest mean value of the set. This measurement is considered a **fail** measurement, even if one of the mean transreflectance measurements does not sit in the allowable range. Upon measurement failure, the acceptable percentage value is calculated and reported in a CSV file. The transreflectance percentage was calculated based on Equation 1:

$$\text{Transreflectance (\%)} = \frac{S_i^{IT}(\lambda) - \bar{D}^{IT}(\lambda)}{\bar{W}^{IT}(\lambda) - \bar{D}^{IT}(\lambda)} \times 100 \quad \text{Eq. 1}$$

Where, S_i is individual drink/sample scans, \bar{D} is the average dark signal, and \bar{W} is the average white signal.

Results

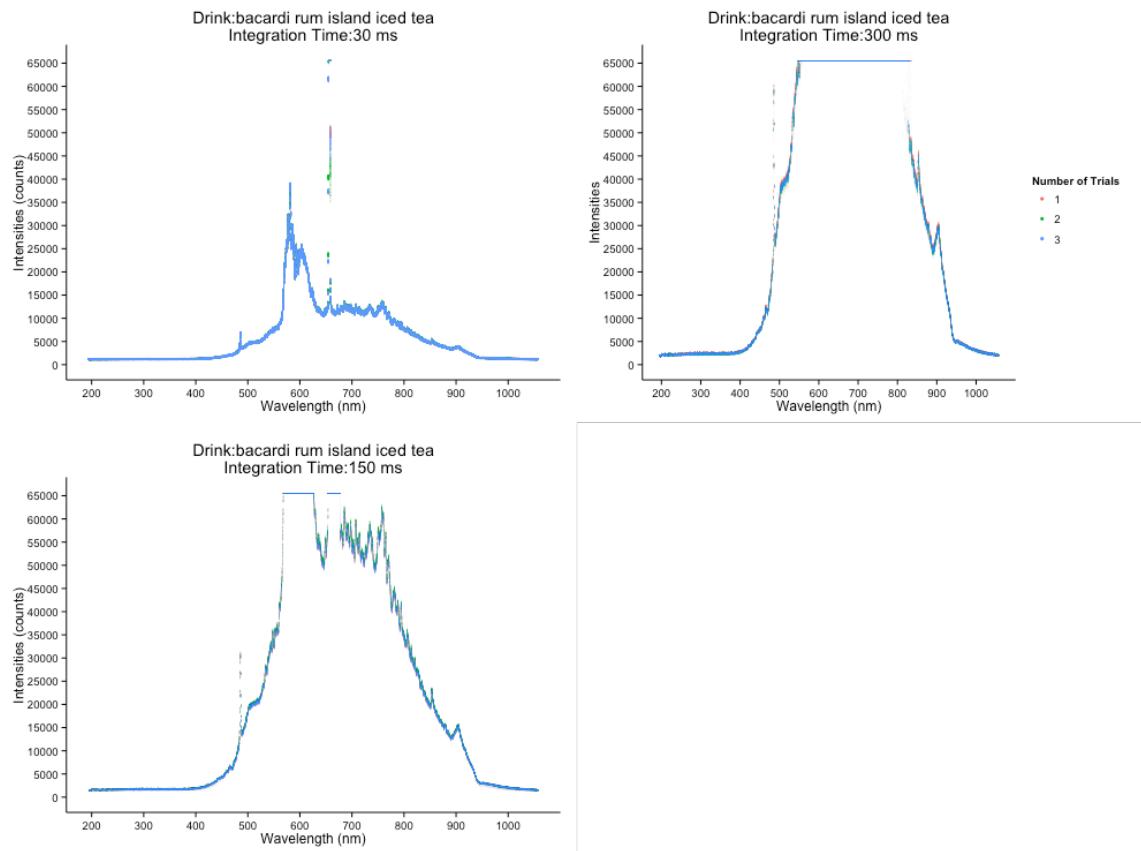
In the following pages, the data is presented in four sections: 1) Drink, 2) White, 3) Dark, and 4) Transreflectance measurements, as can be seen in Appendix A-D respectively. In each section, the drinks are listed alphabetically under twelve different categories: Alcohol, beer, coffee, energy, juice, milk, other, soda, sport, tea, water, and wine. The summary of data set (e.g. number of trials, clipping percentage, etc.) is provided as a supplementary CSV file.

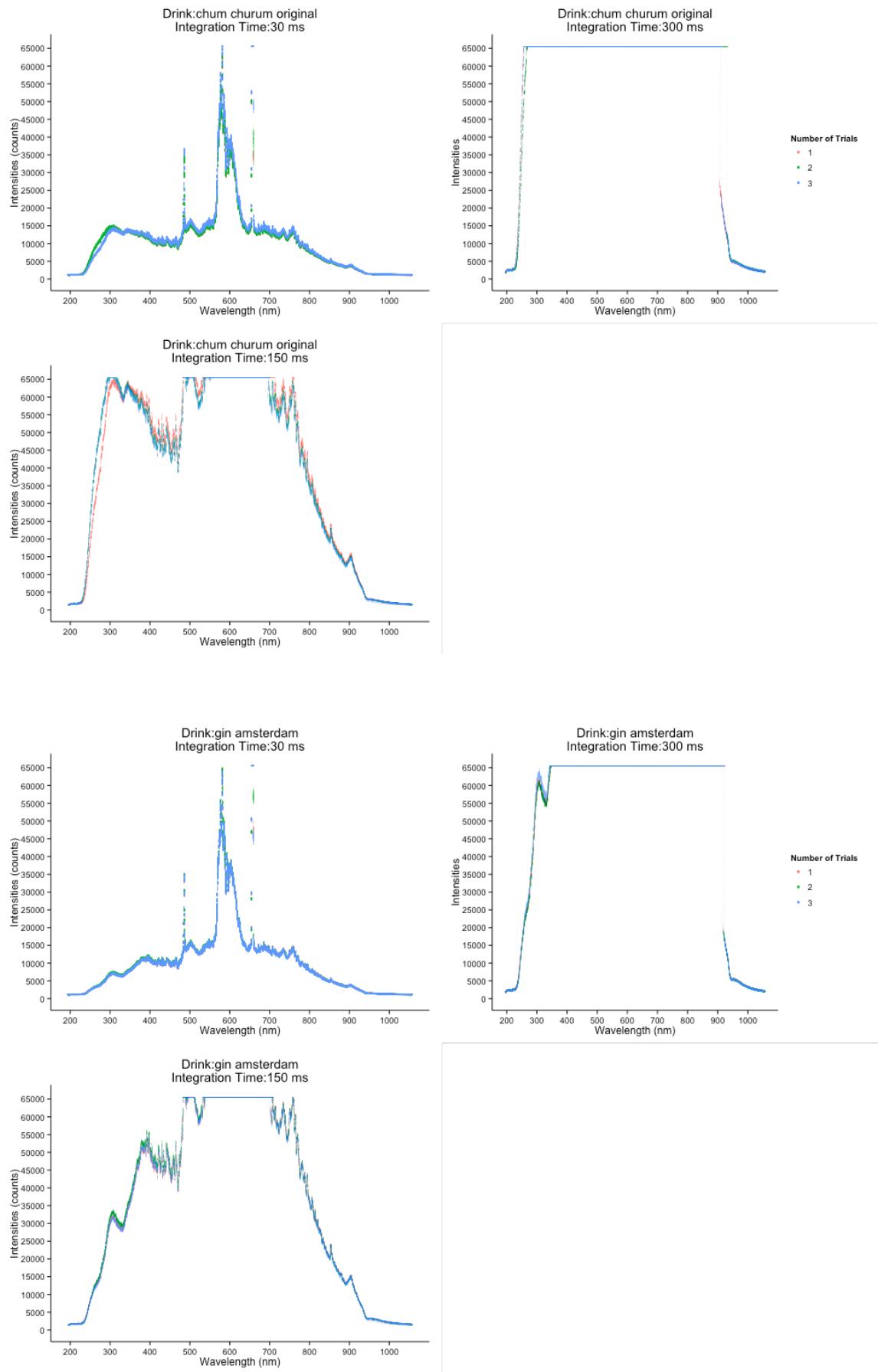
Summary

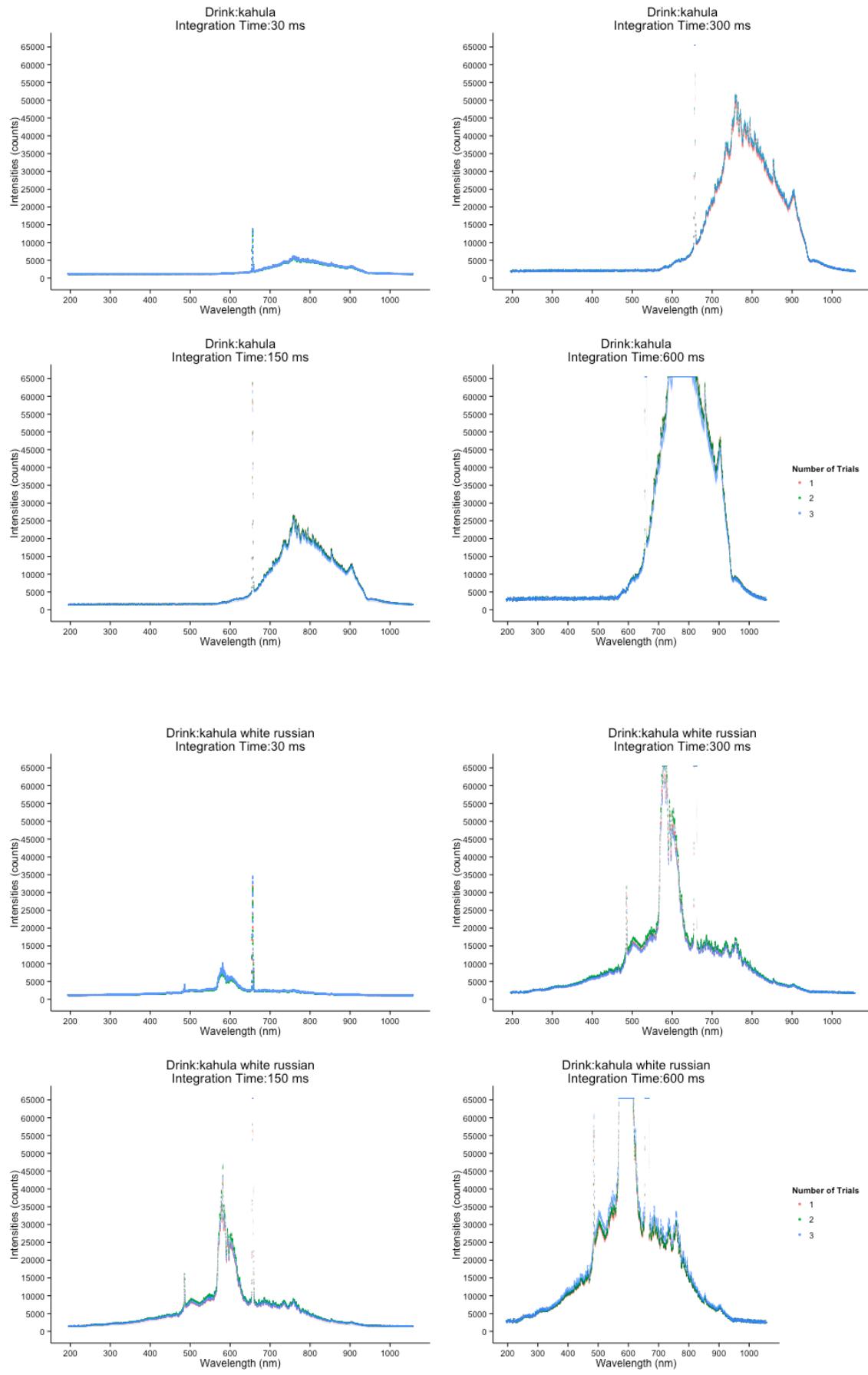
The data collection for 100 drinks with three replications in a randomized style was completed. The drink, white, dark, and transreflectance spectra were graphed. A total of 93 drinks have three trial measurements, and 7 drinks have two trials. At 30 ms integration time, the maximum signal saturation was less than 1% along all spectra. All the spectra contain UV, VIS, and NIR regions. The data was recorded in XML format. A supplementary CSV file, summarizing all the QA measurements was provided. It was noticed with the 1% criterion for between-trial acceptance, only 20% of the drinks pass.

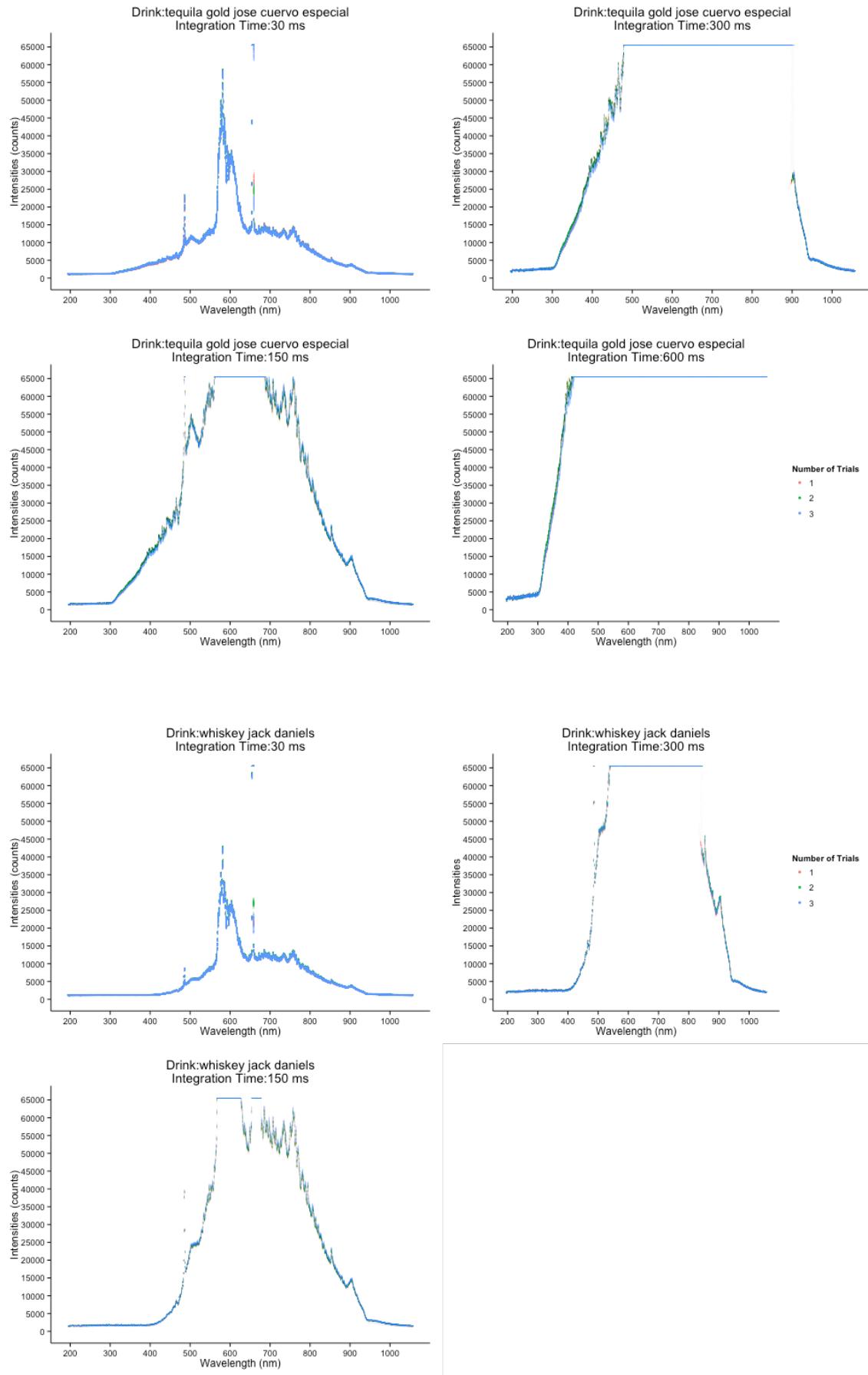
Appendix A-Drinks

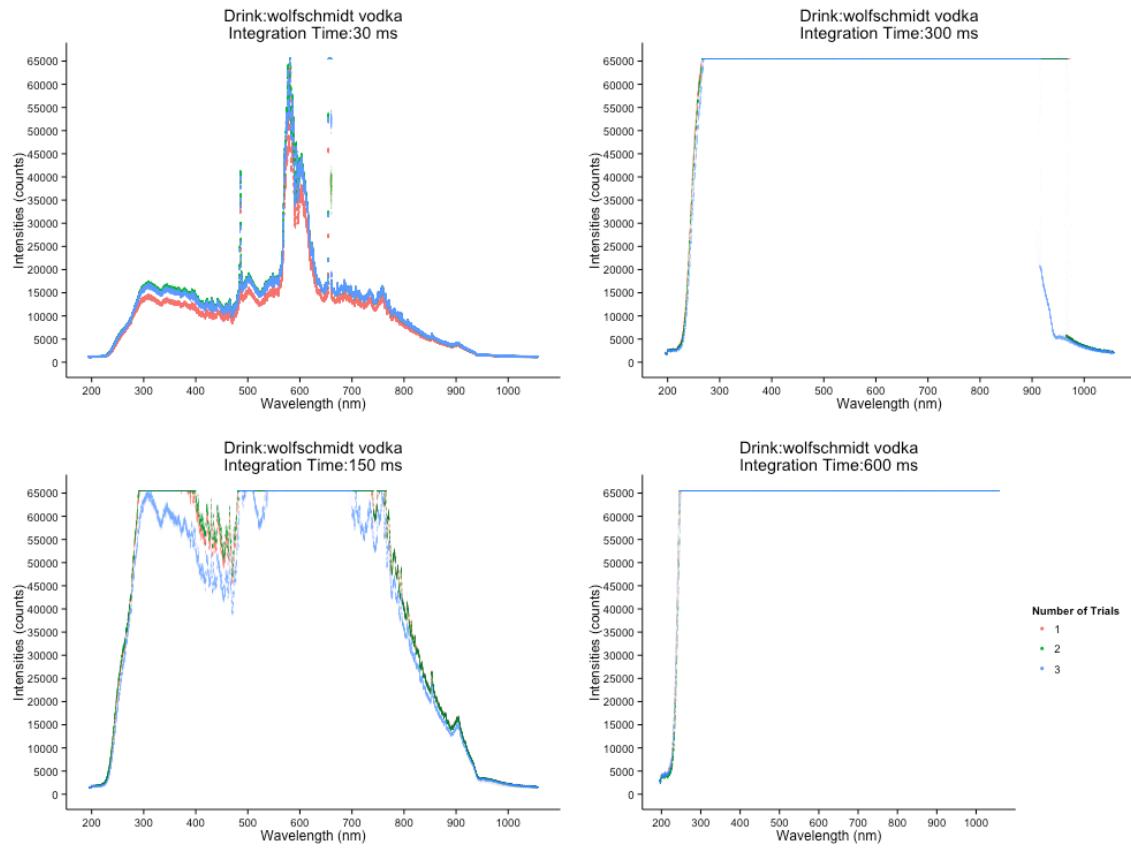
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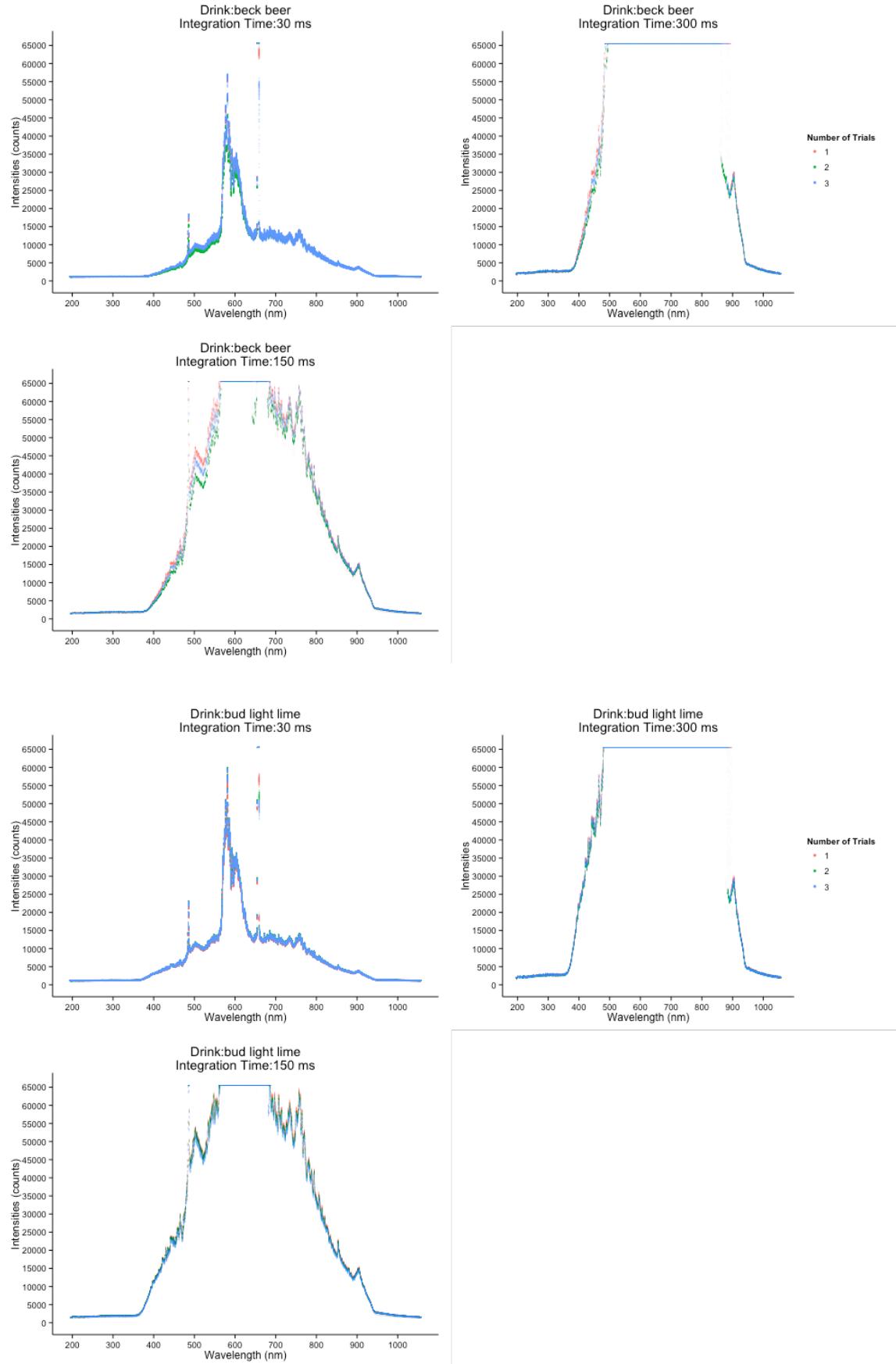


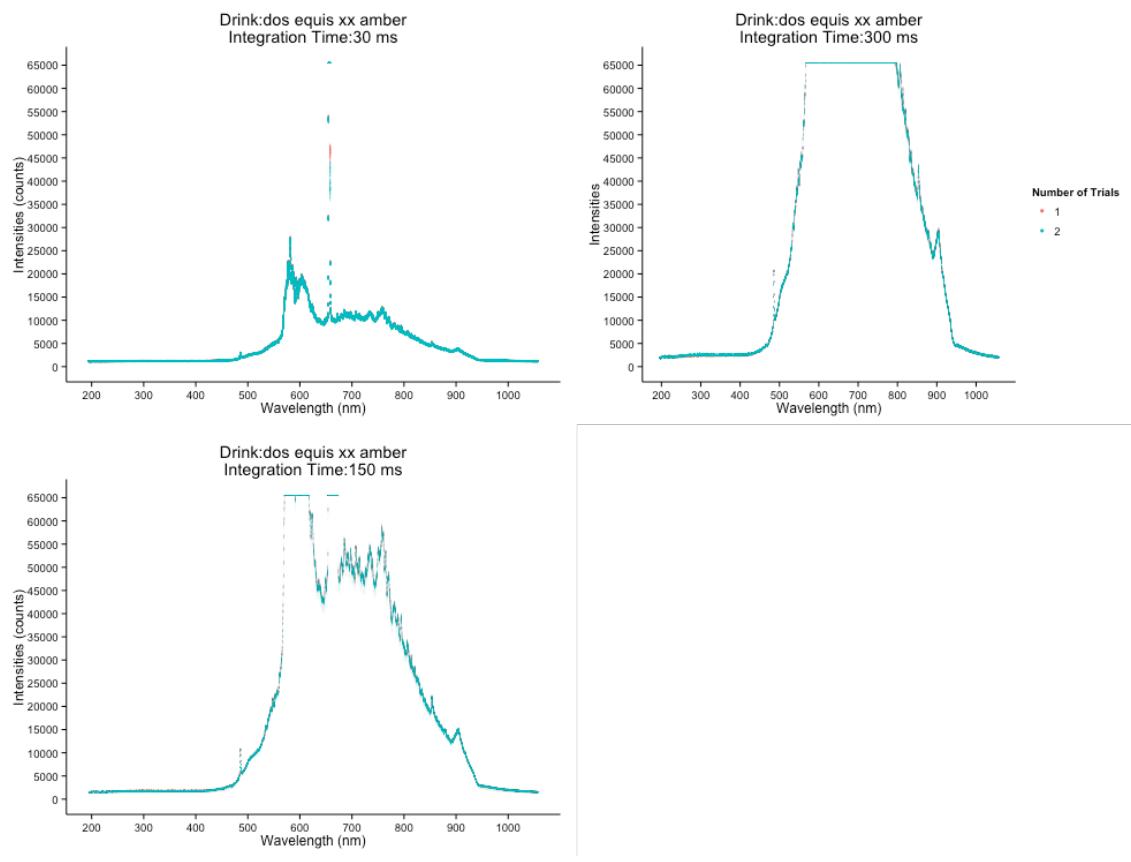
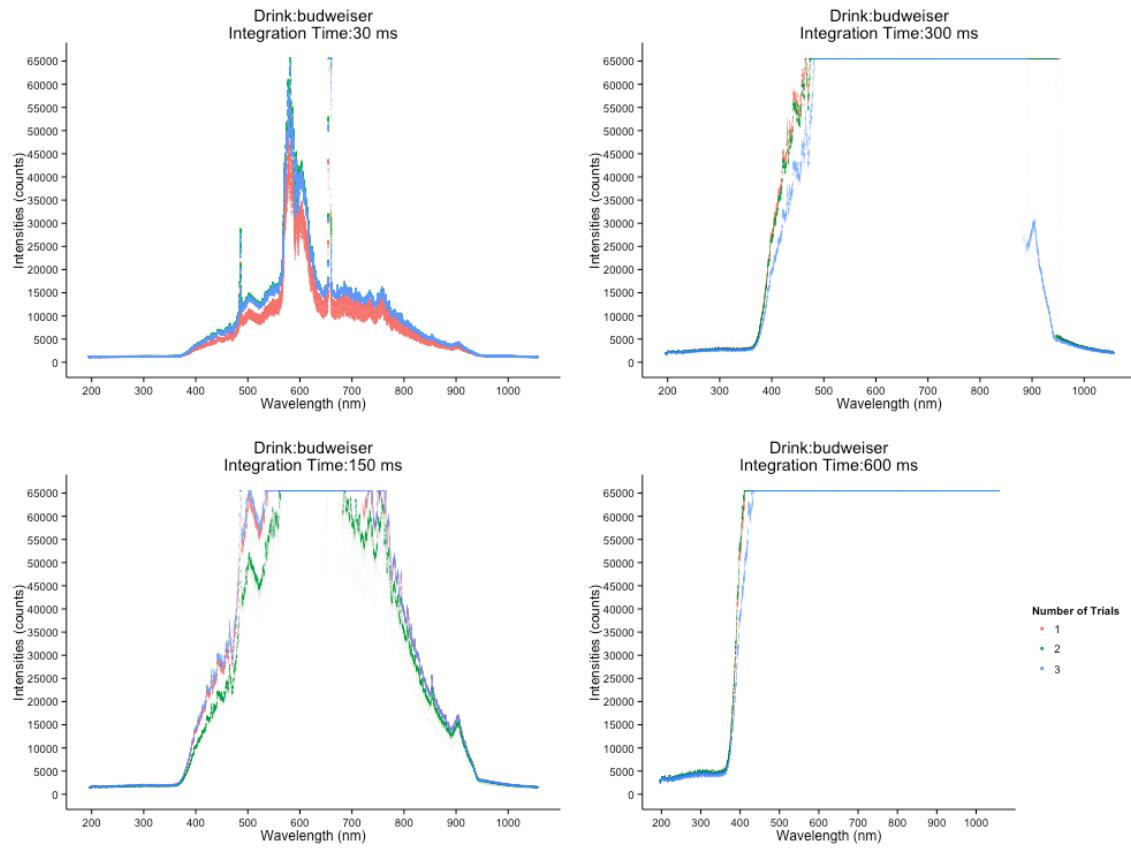


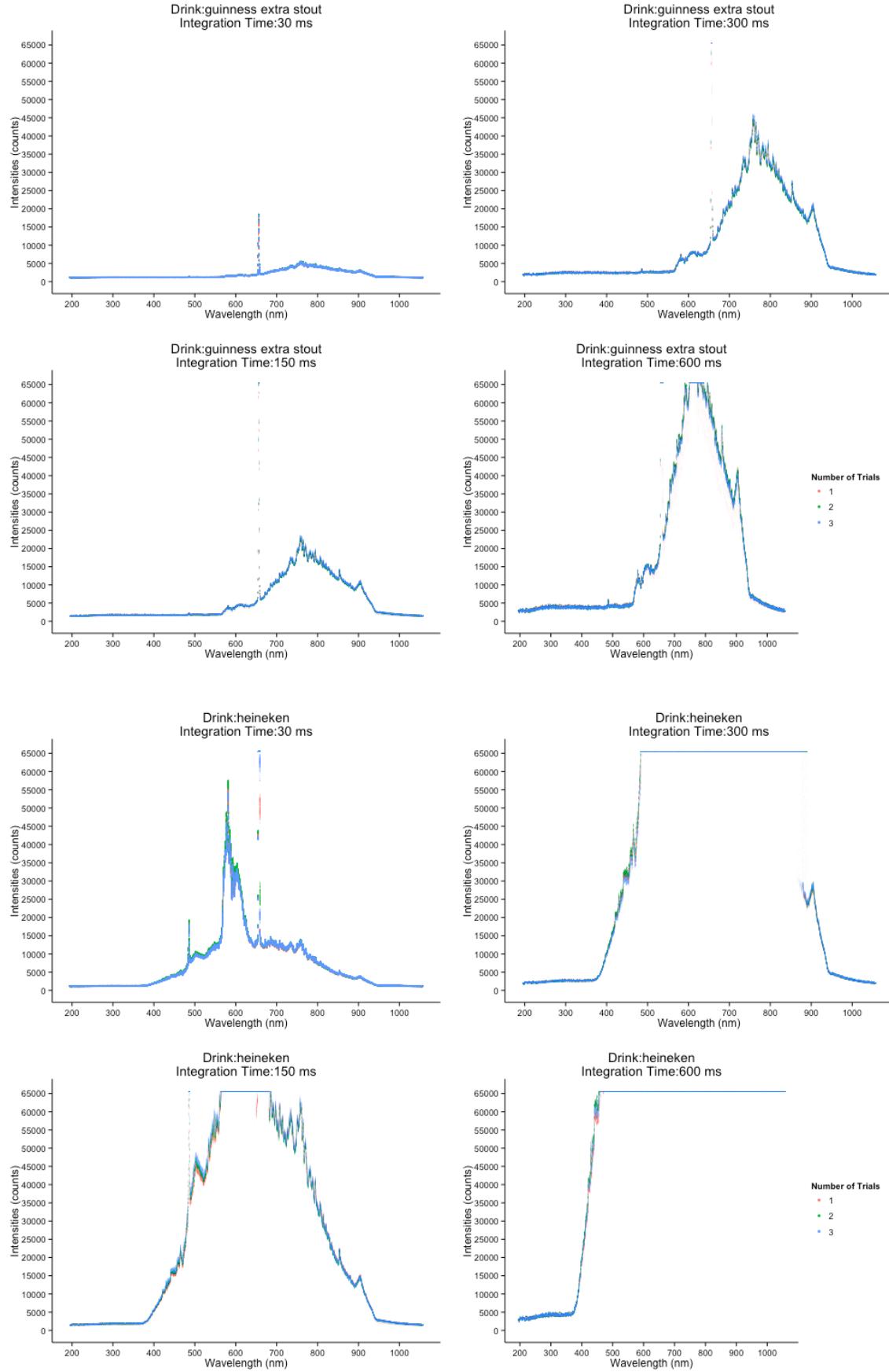


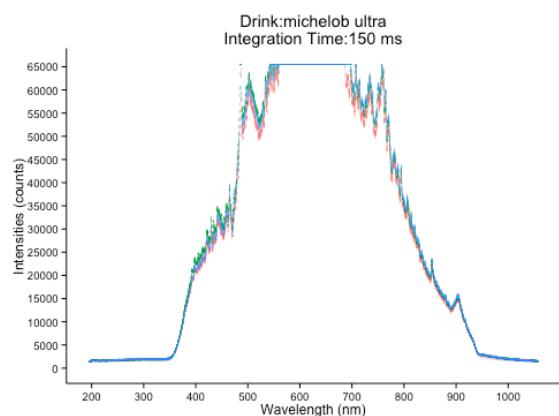
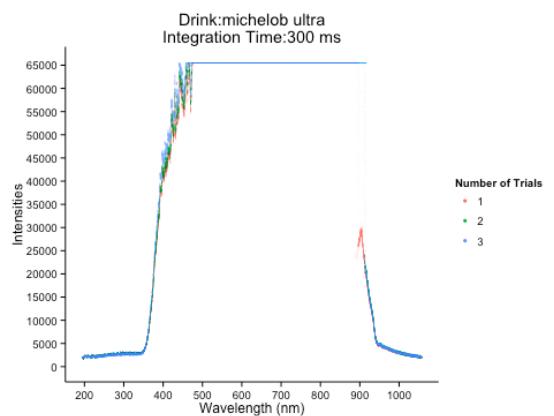
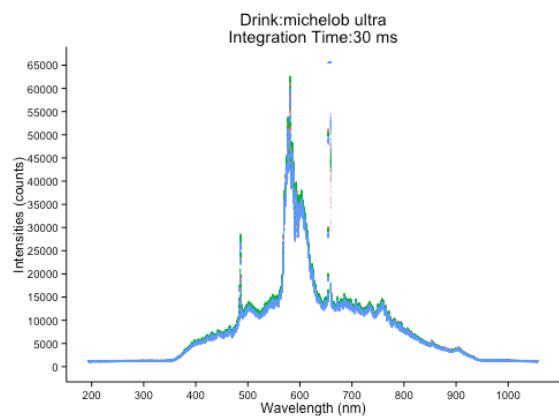
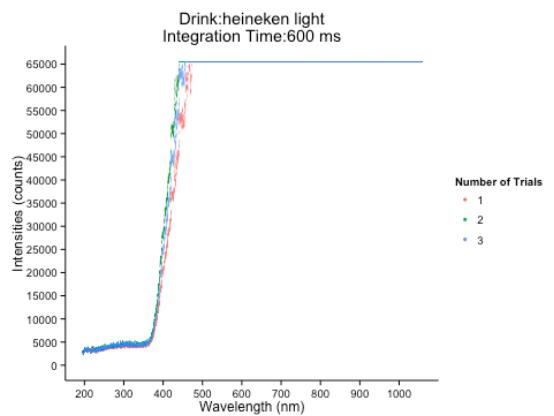
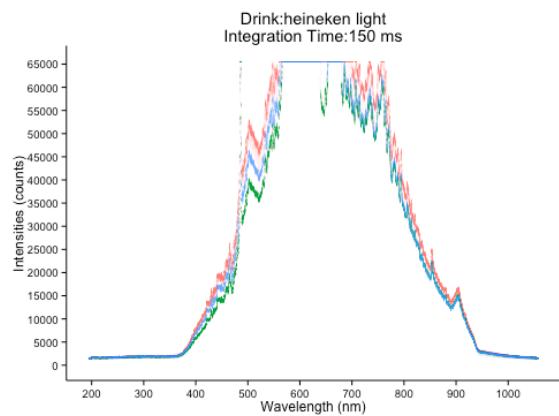
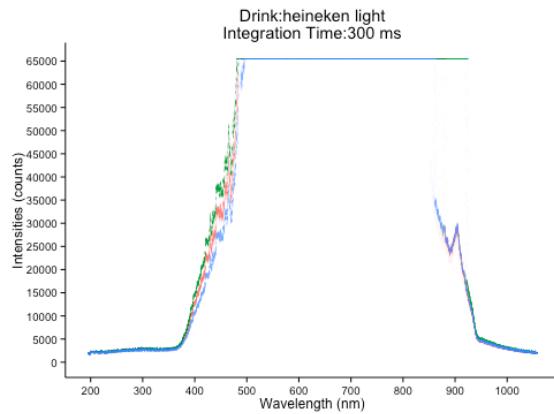
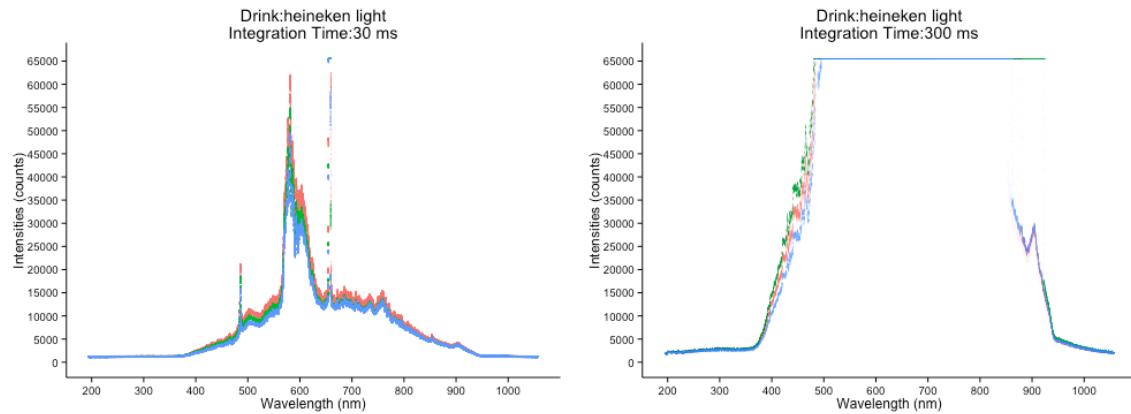


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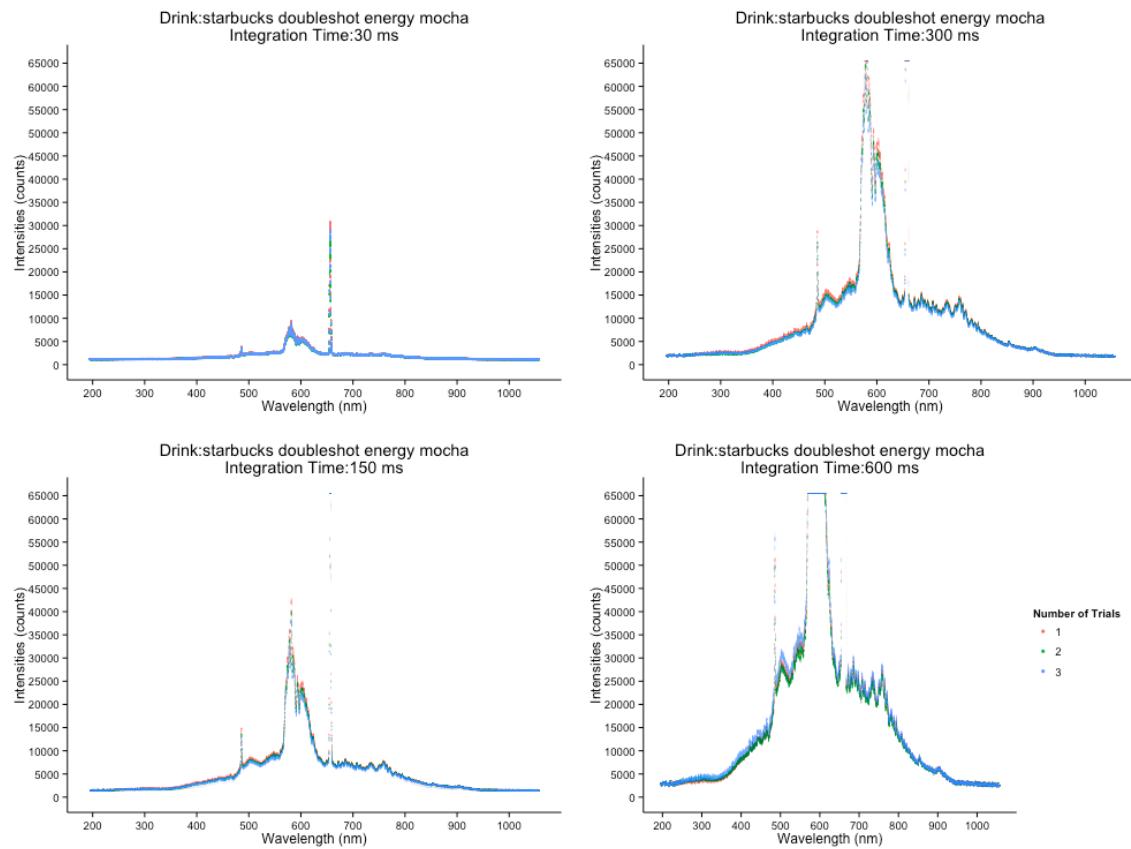


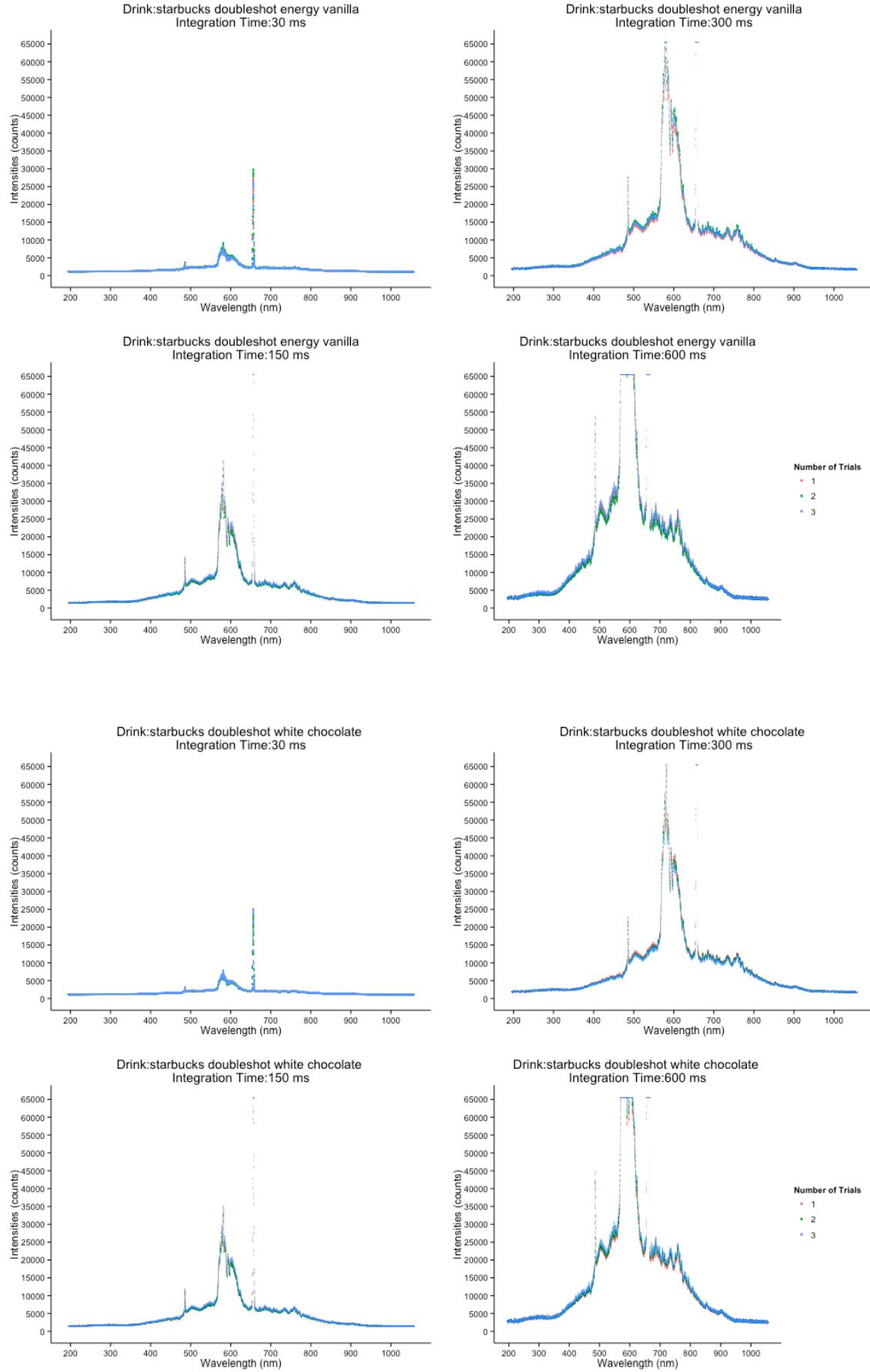


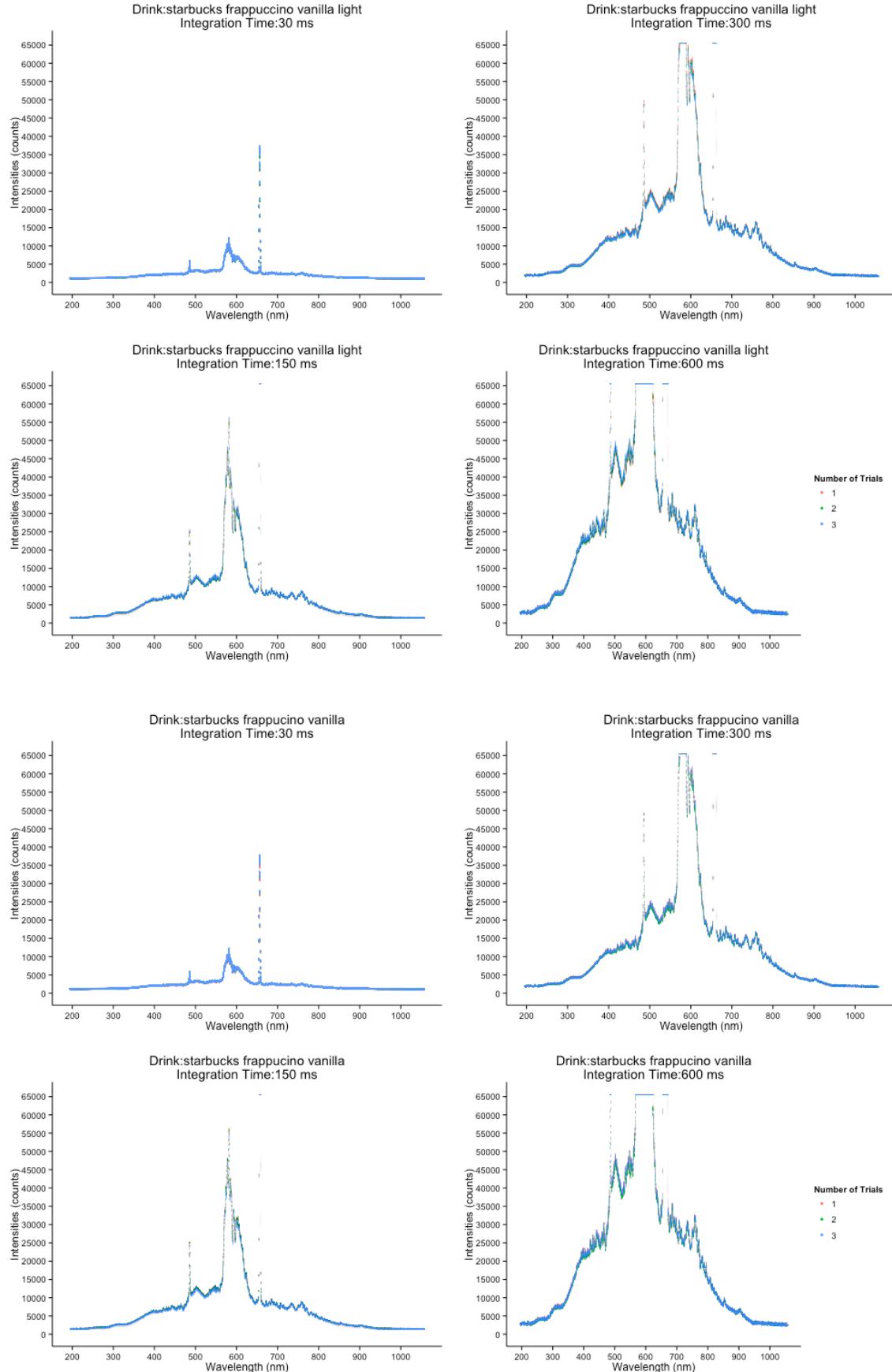


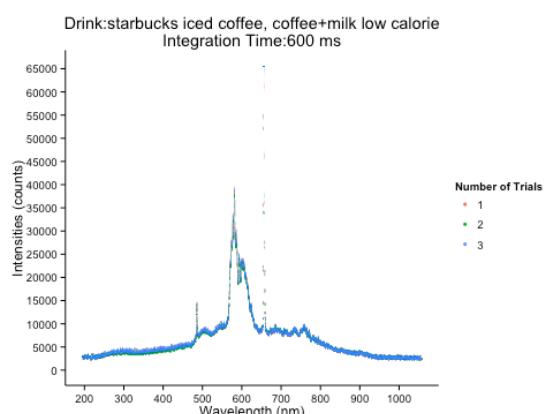
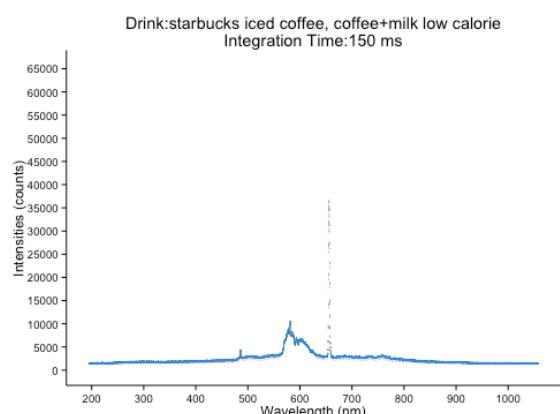
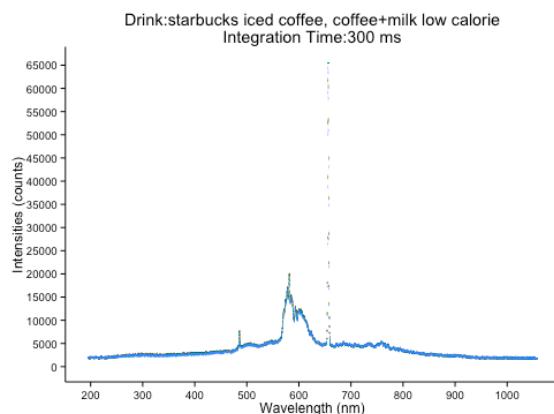
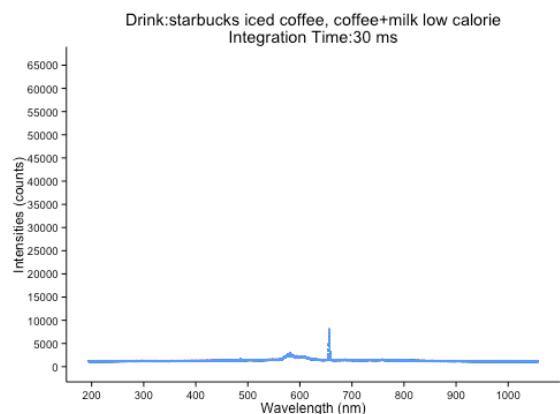
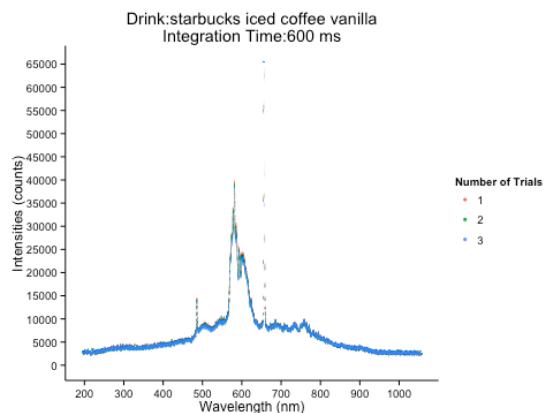
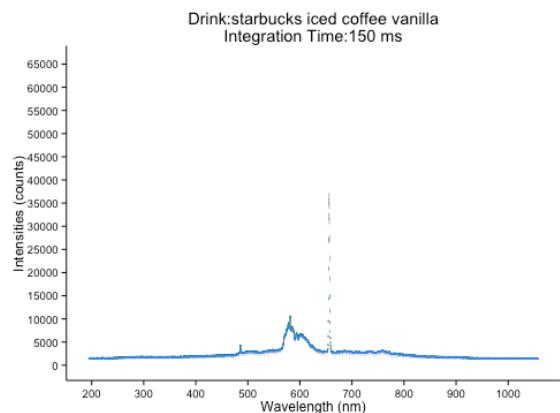
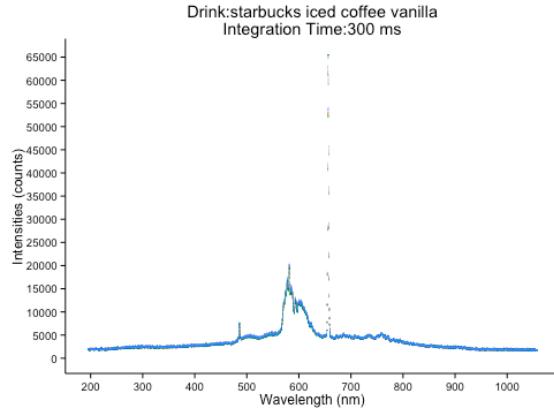
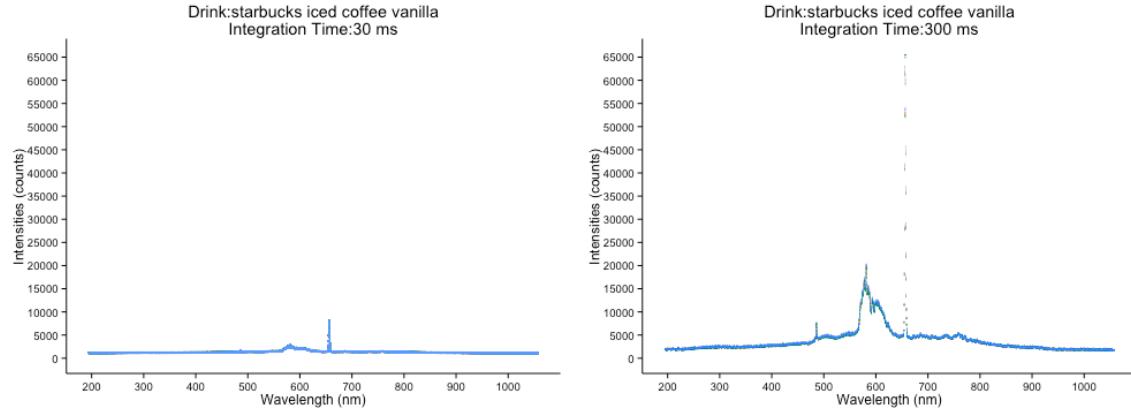


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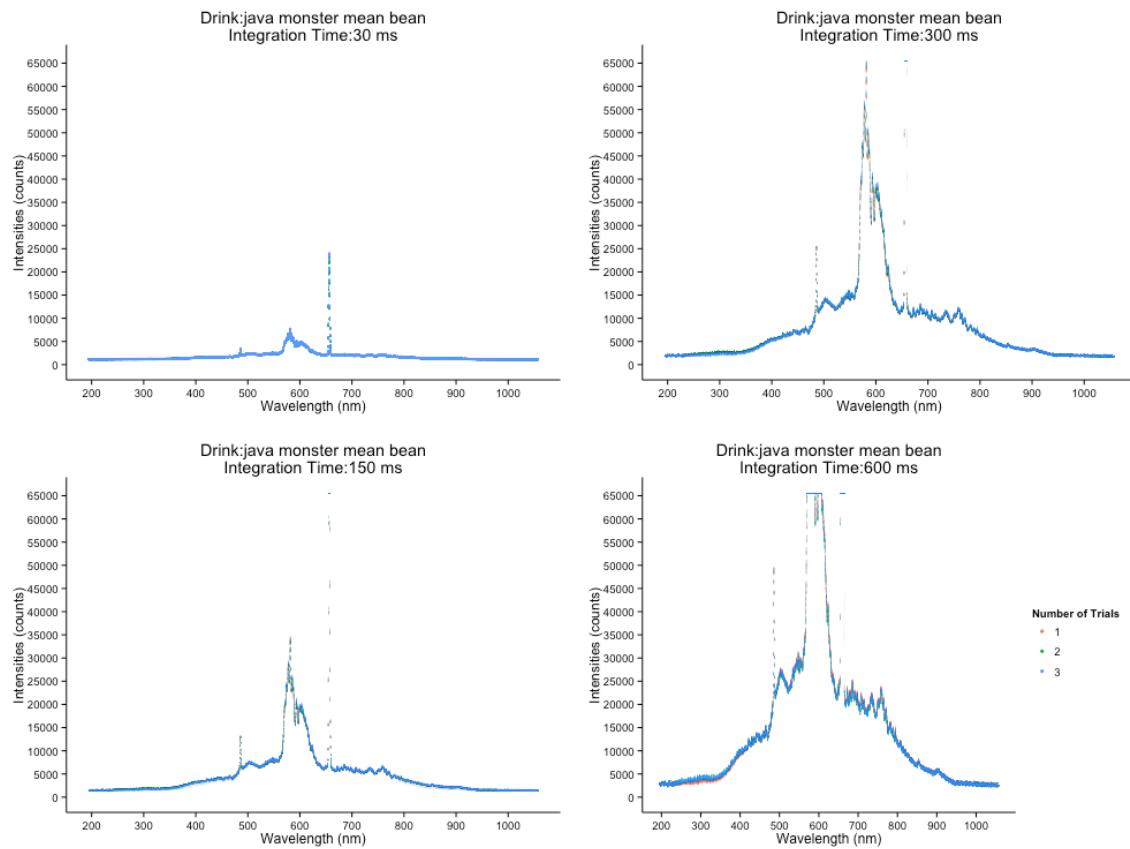


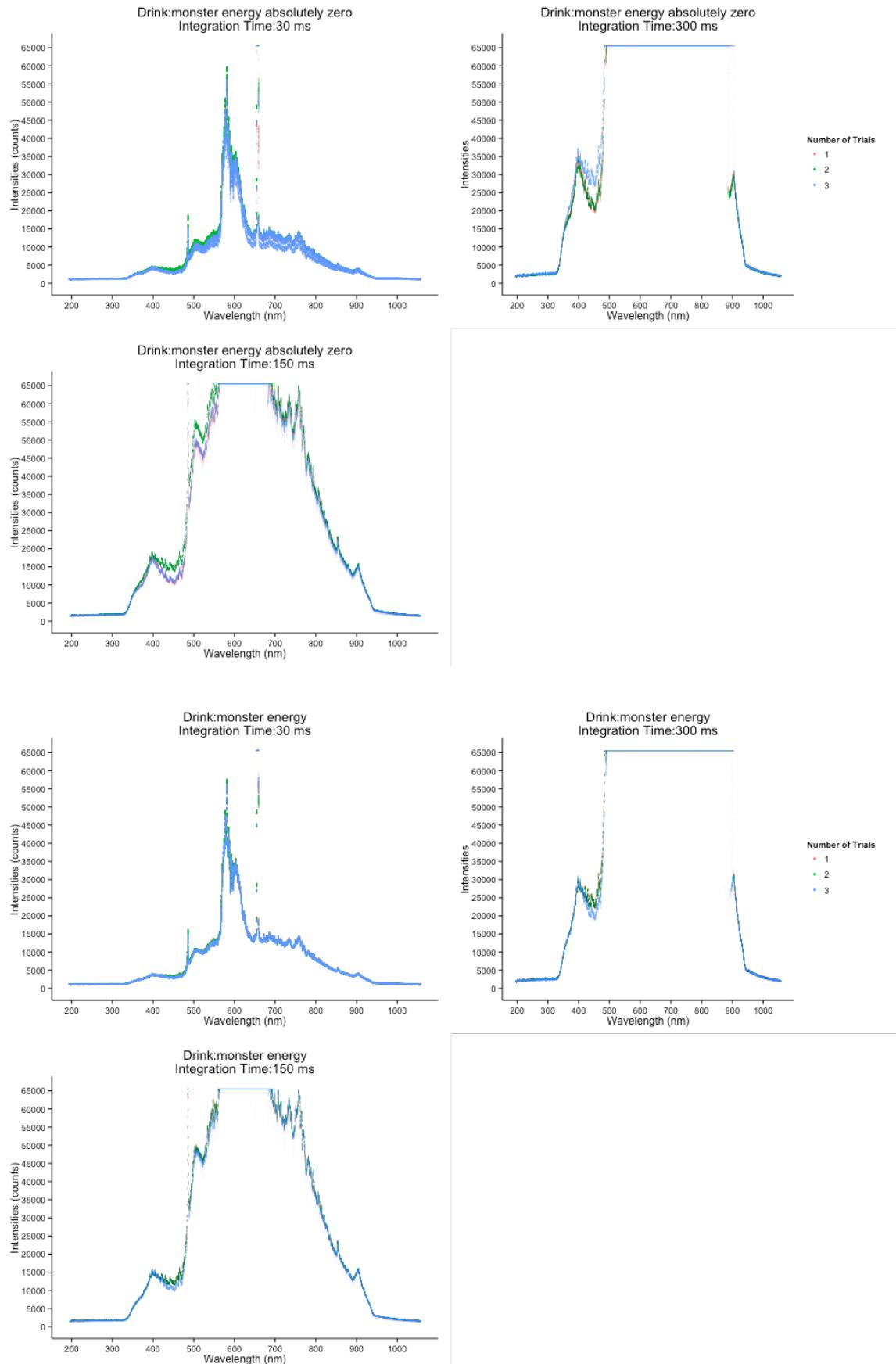


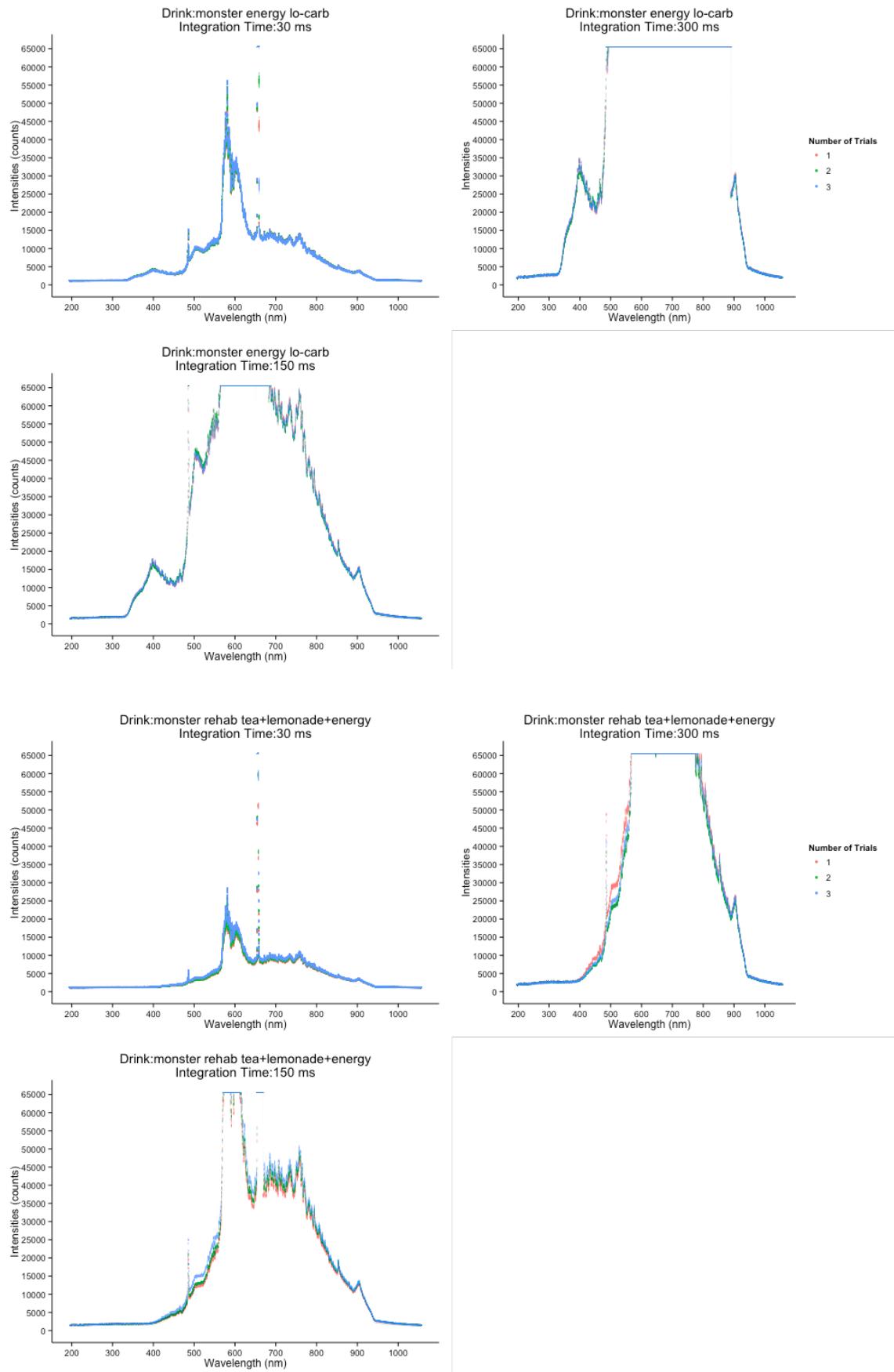


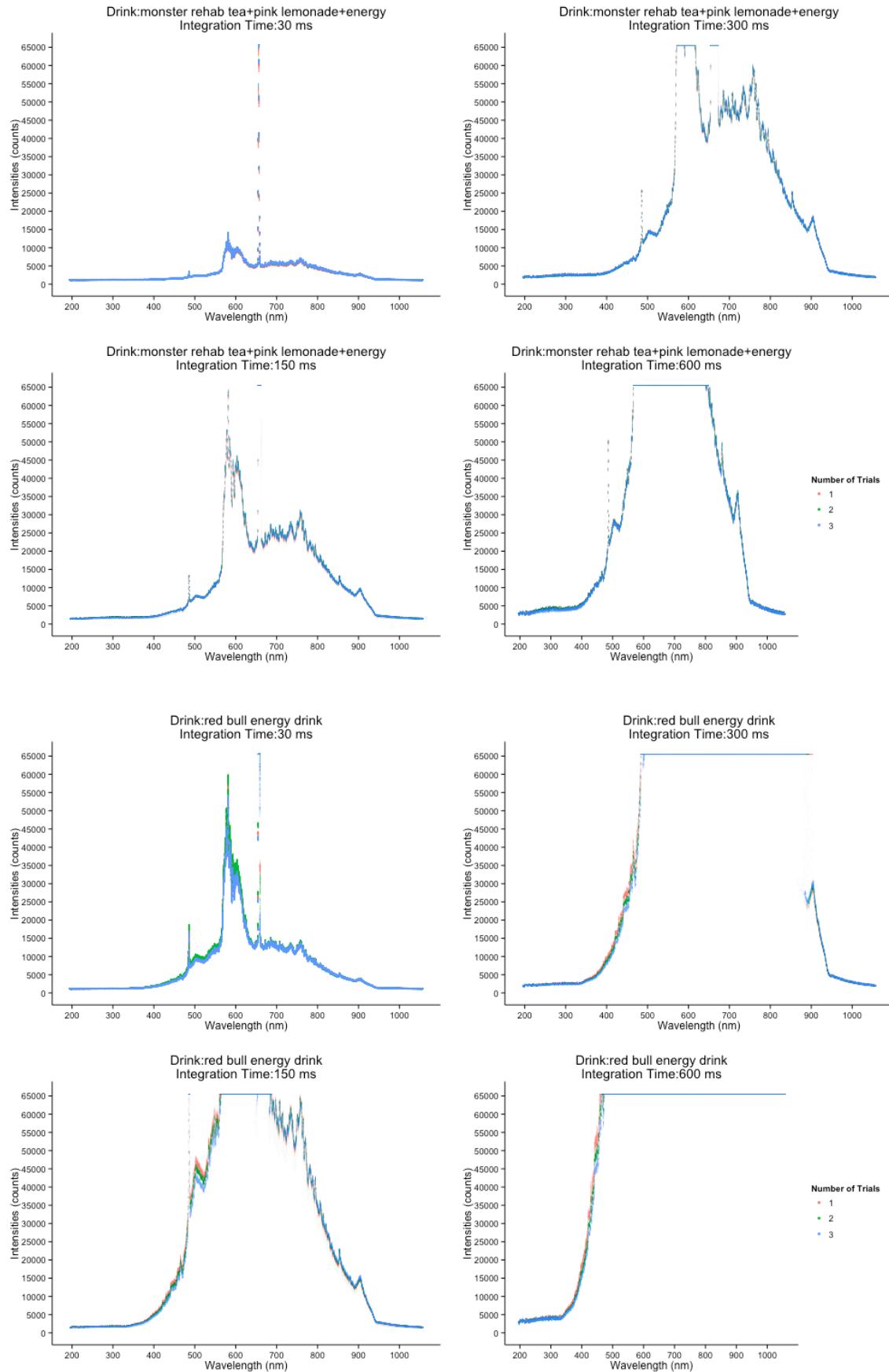


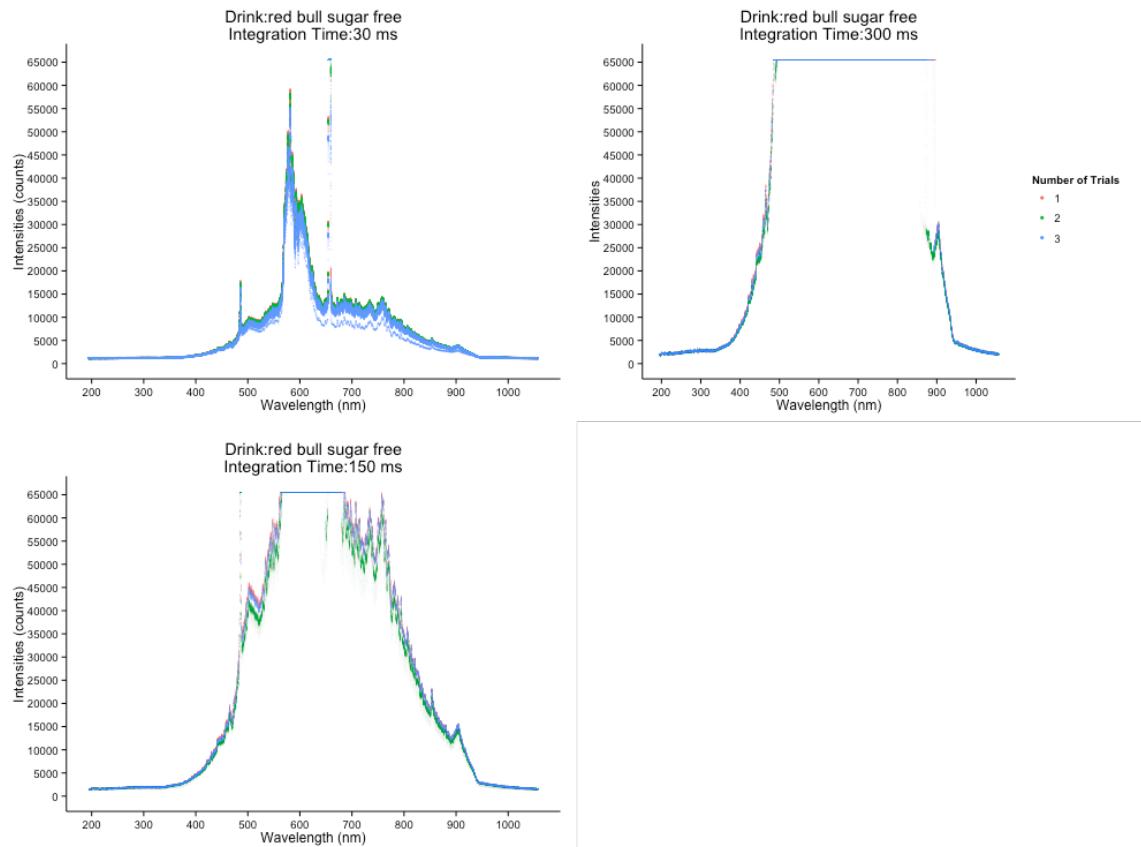
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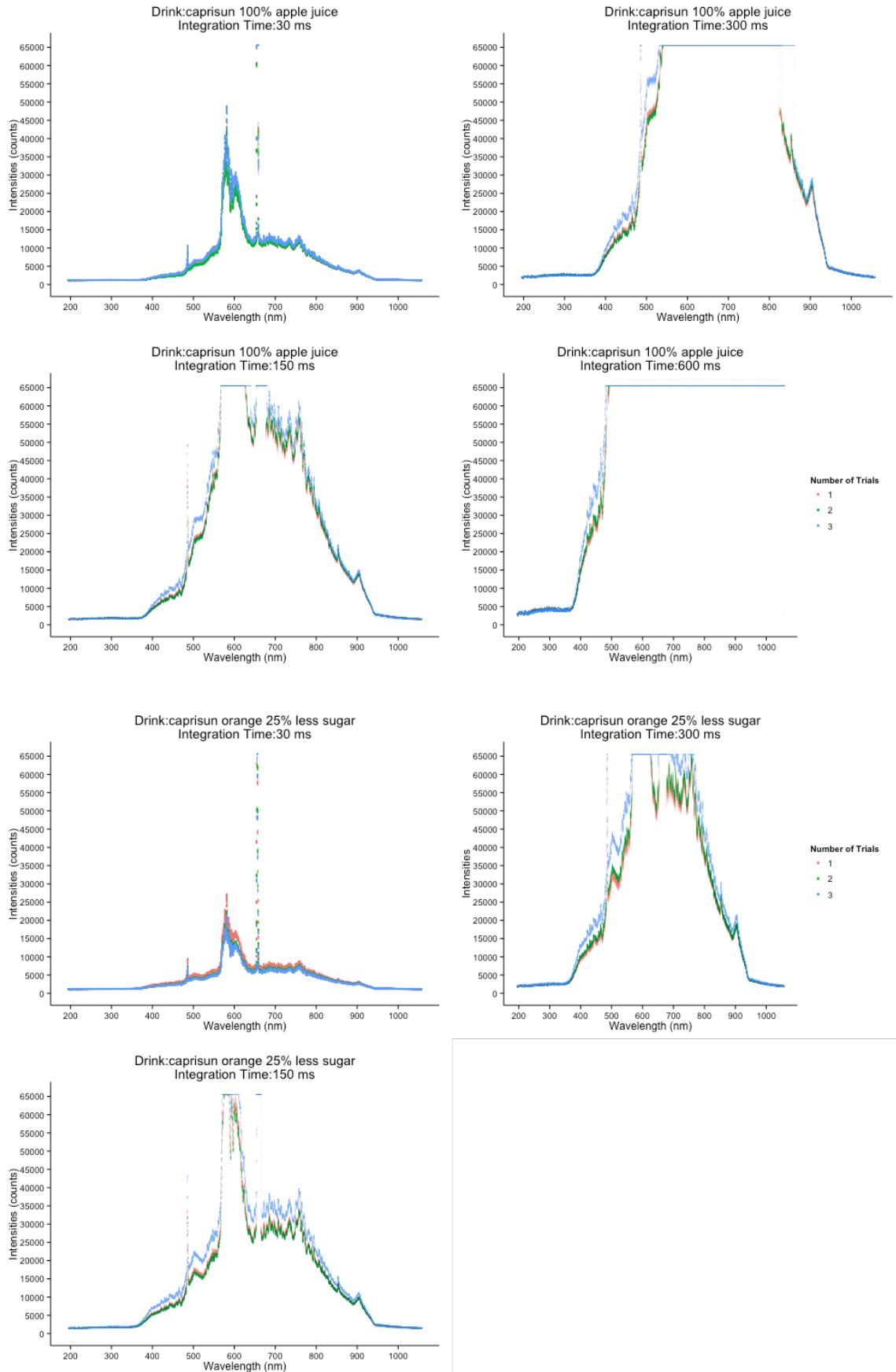


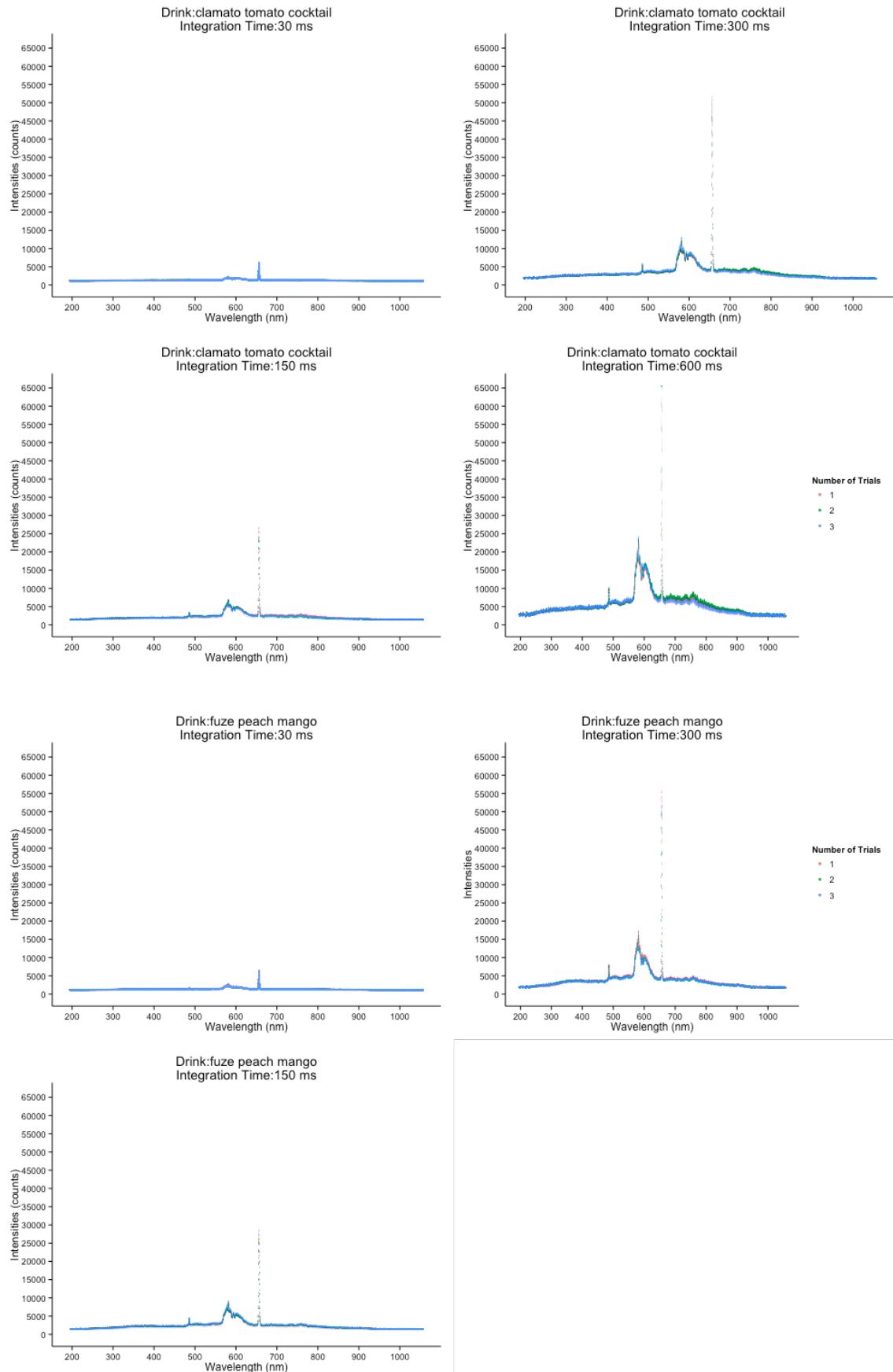


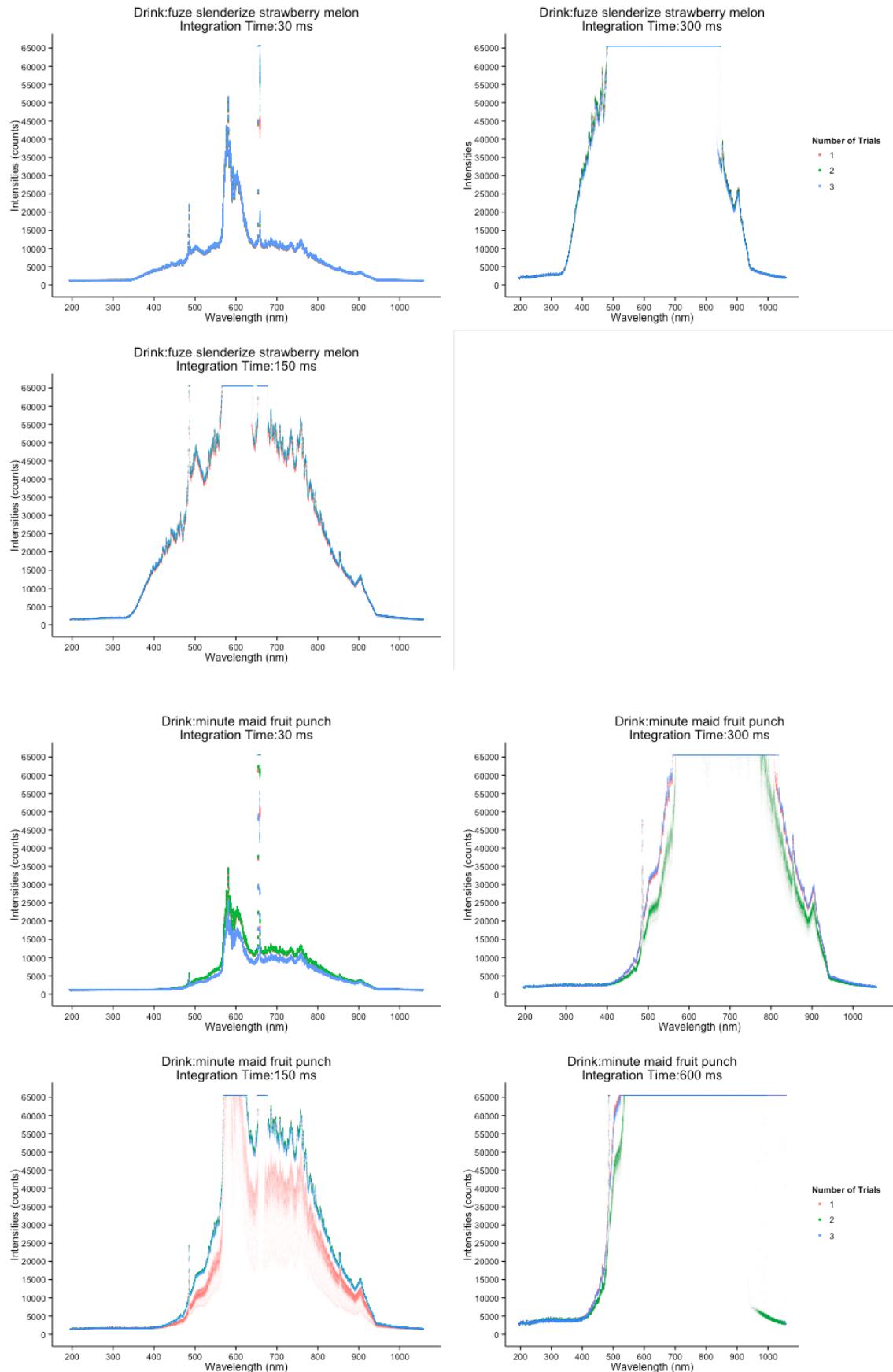


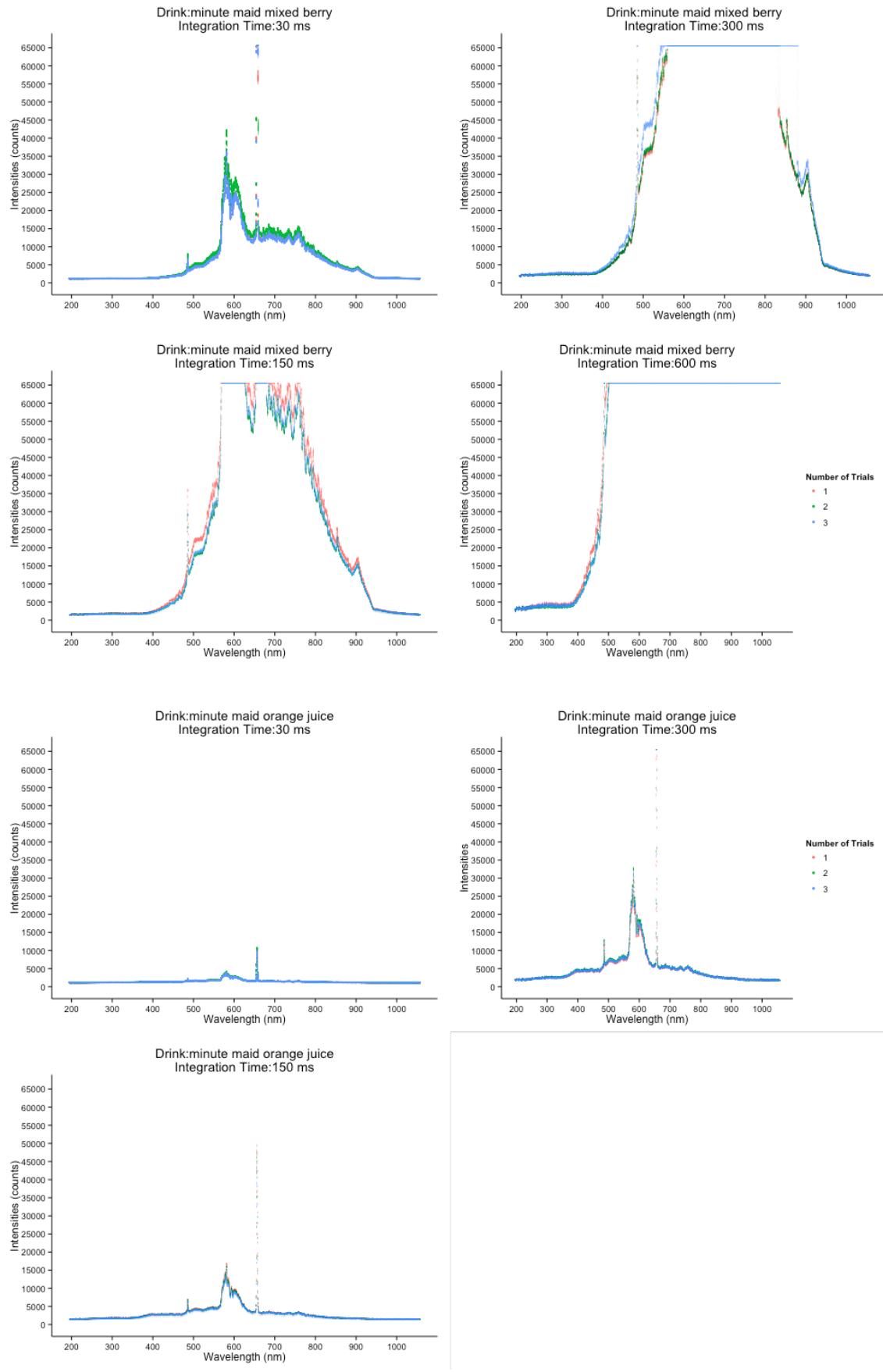


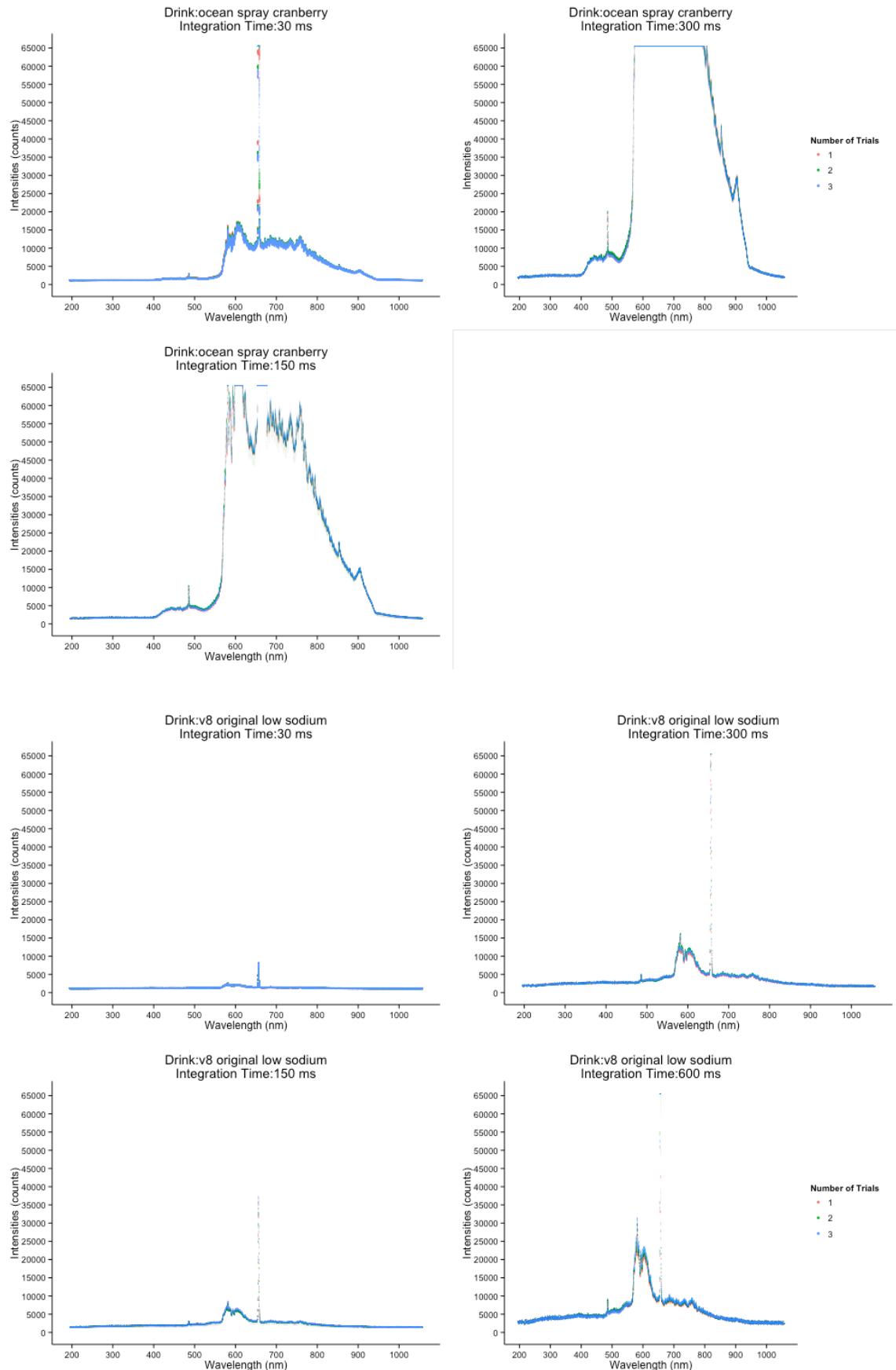
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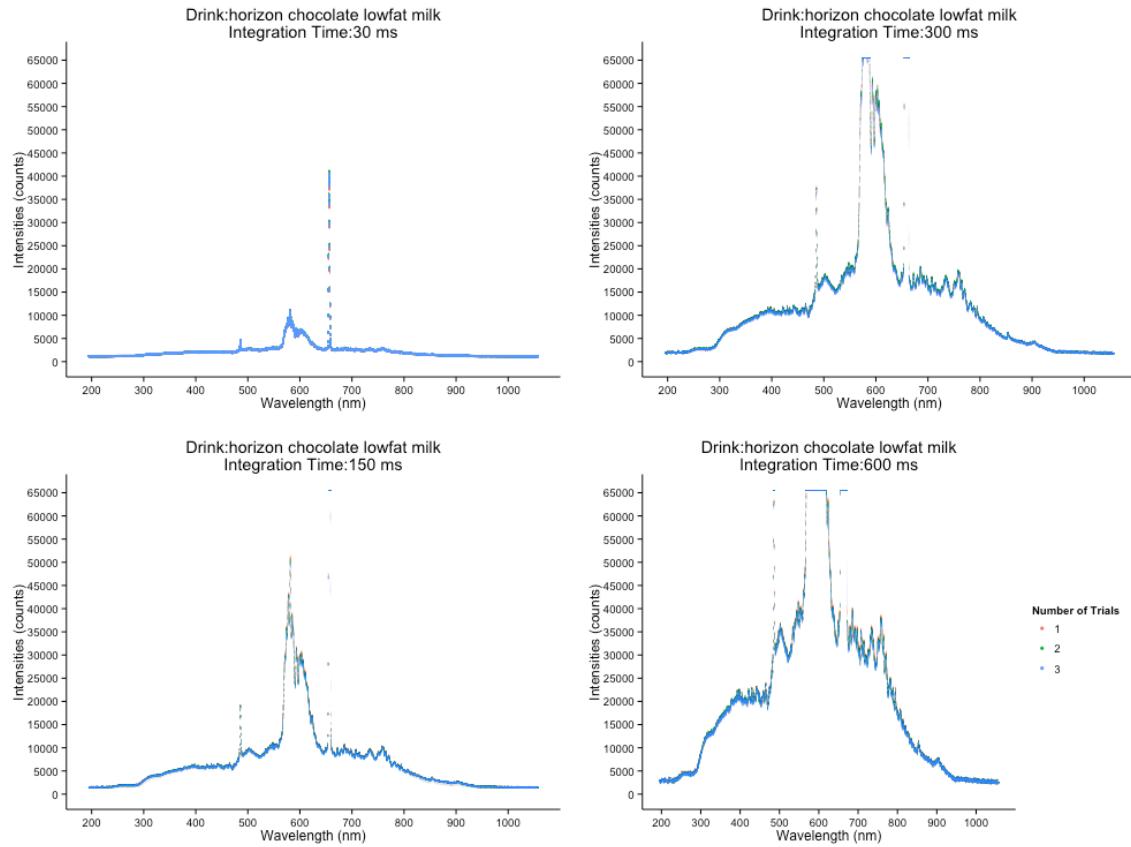


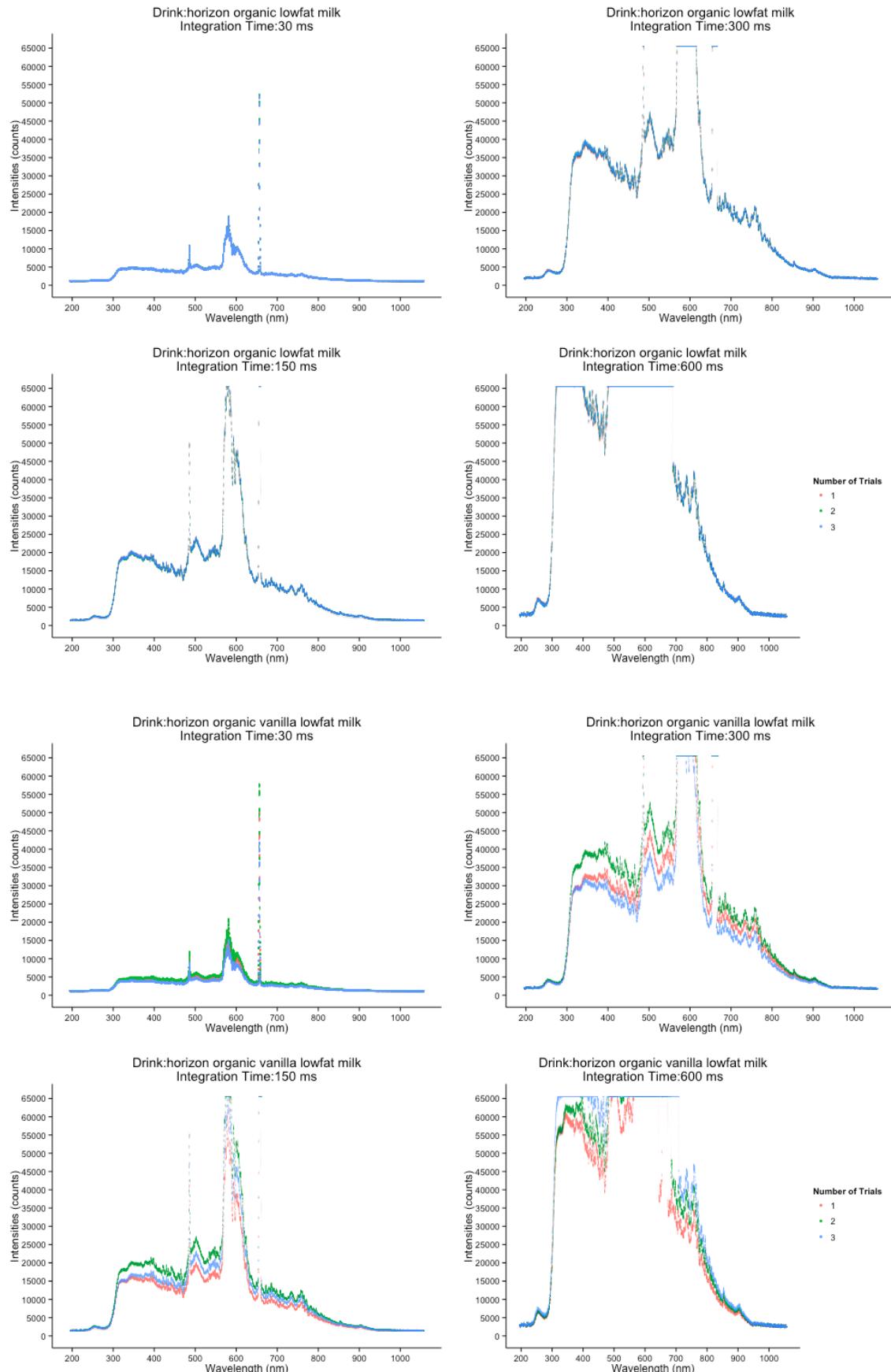


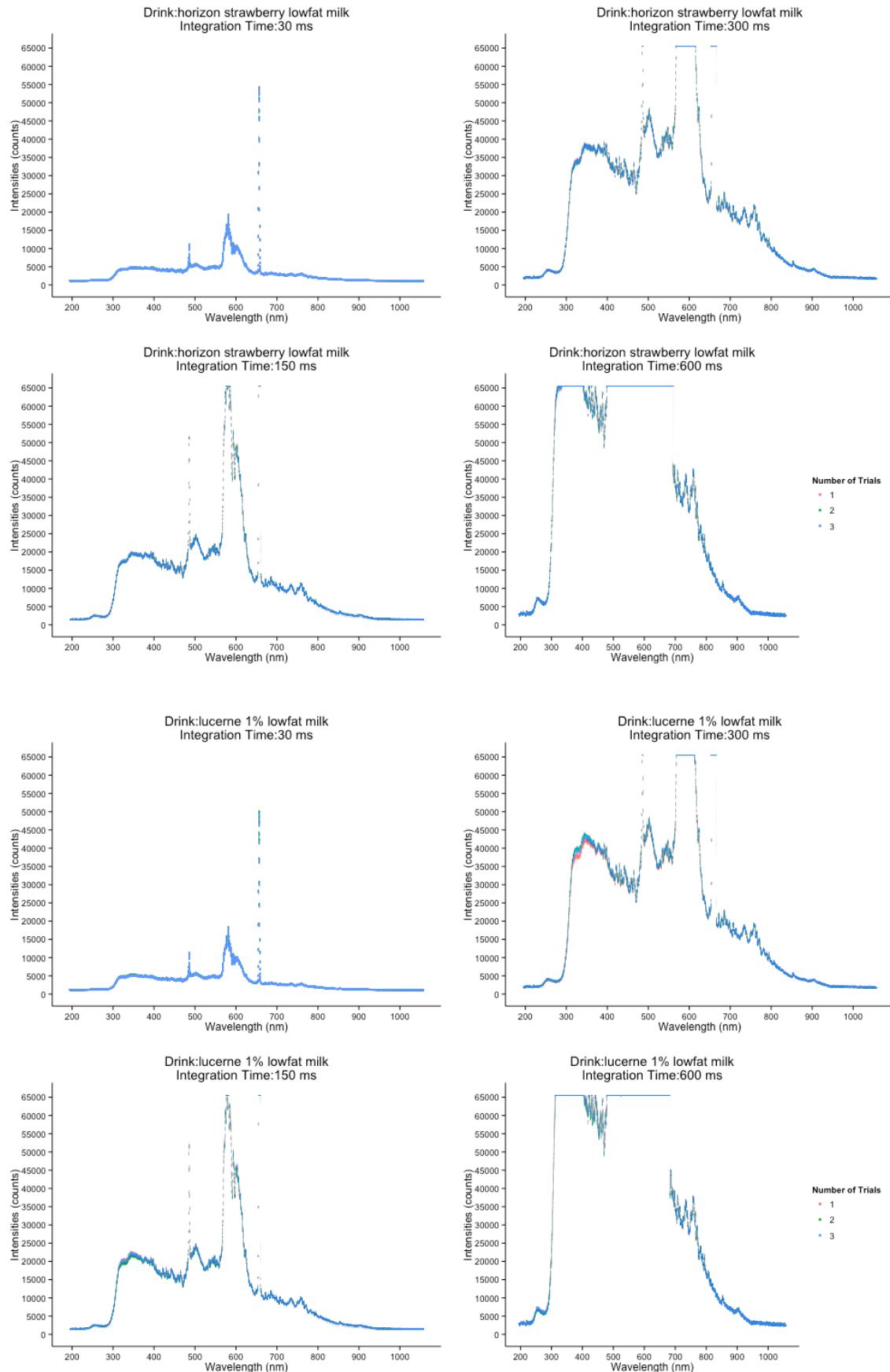


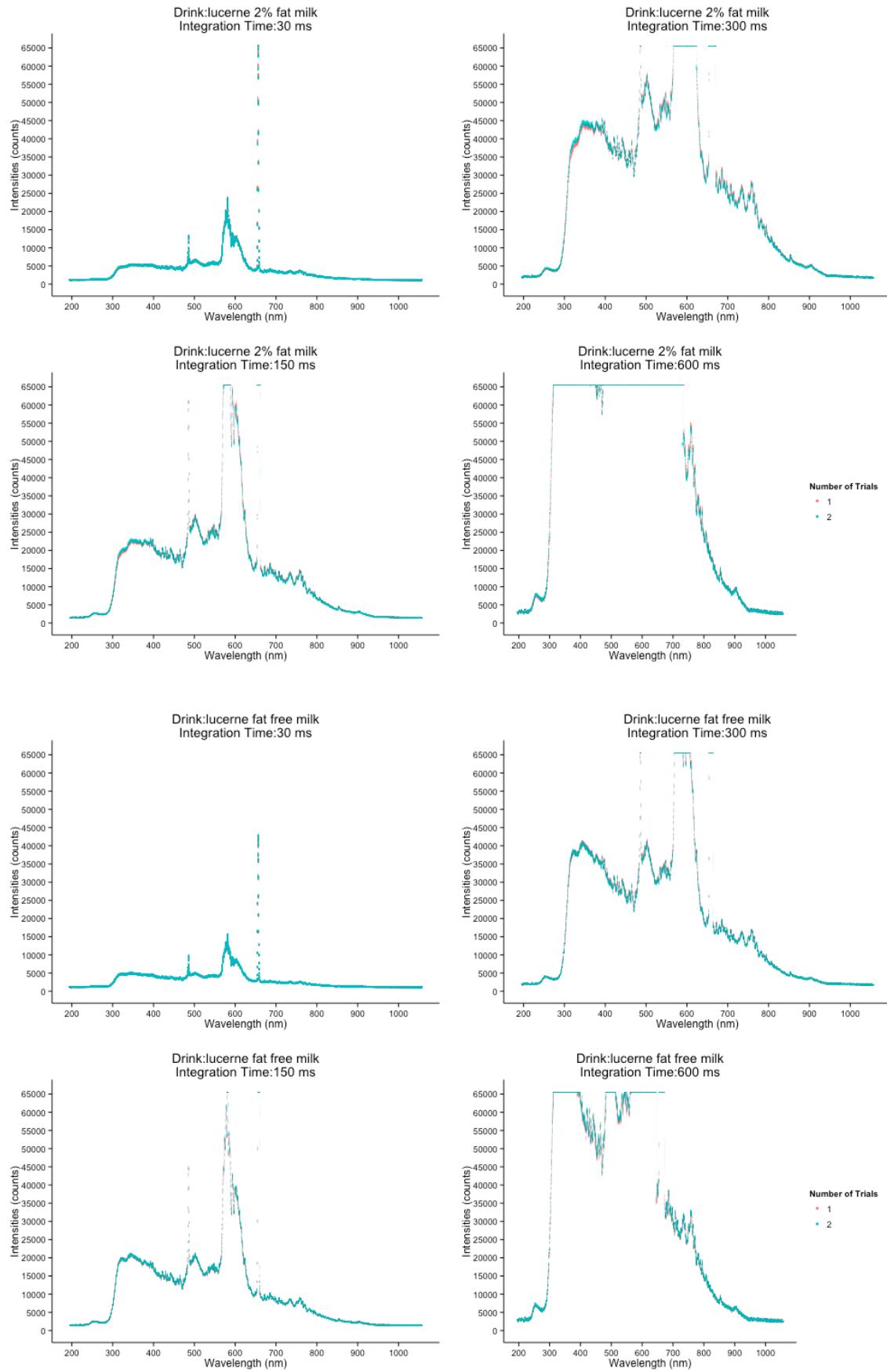


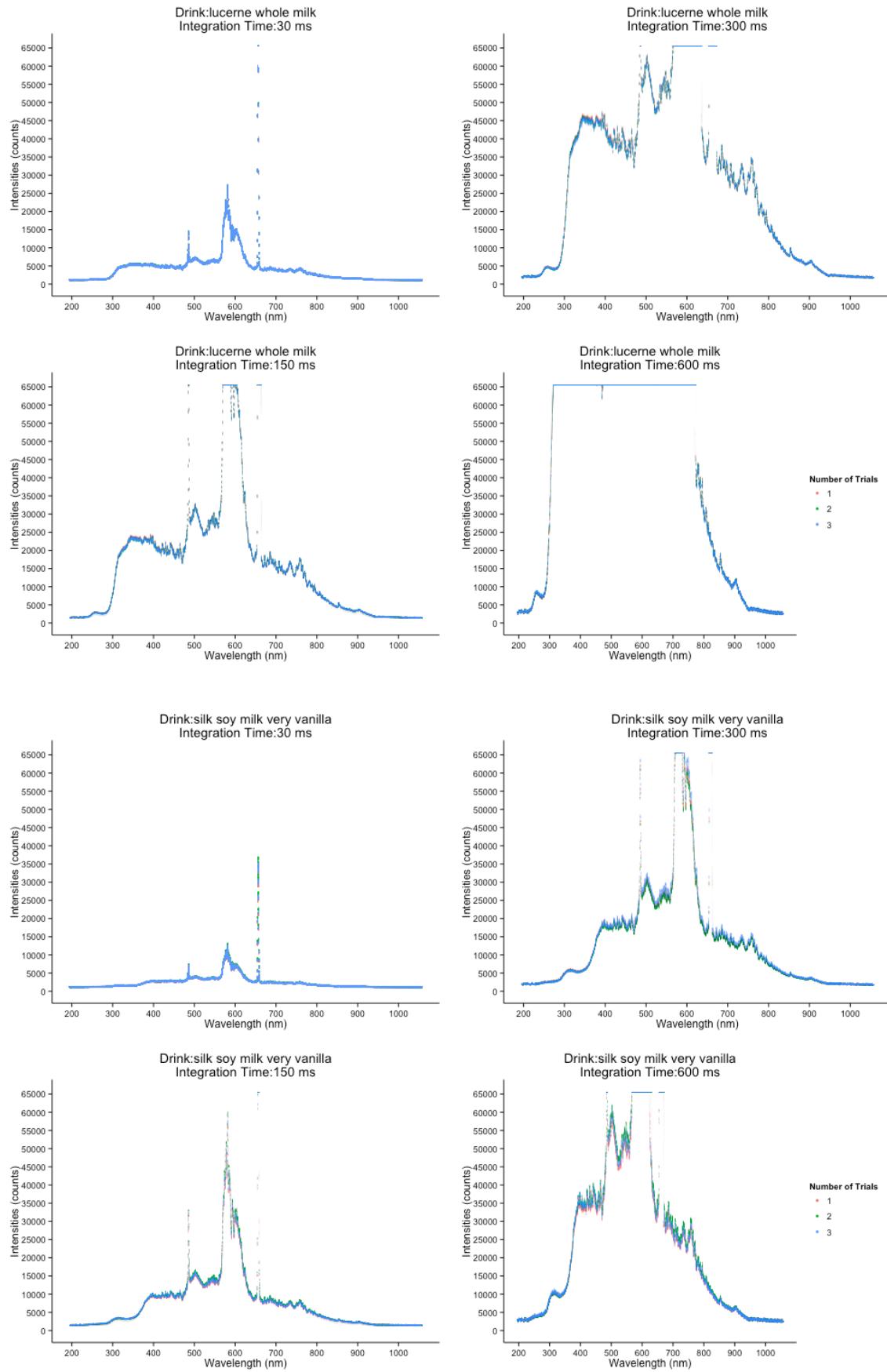
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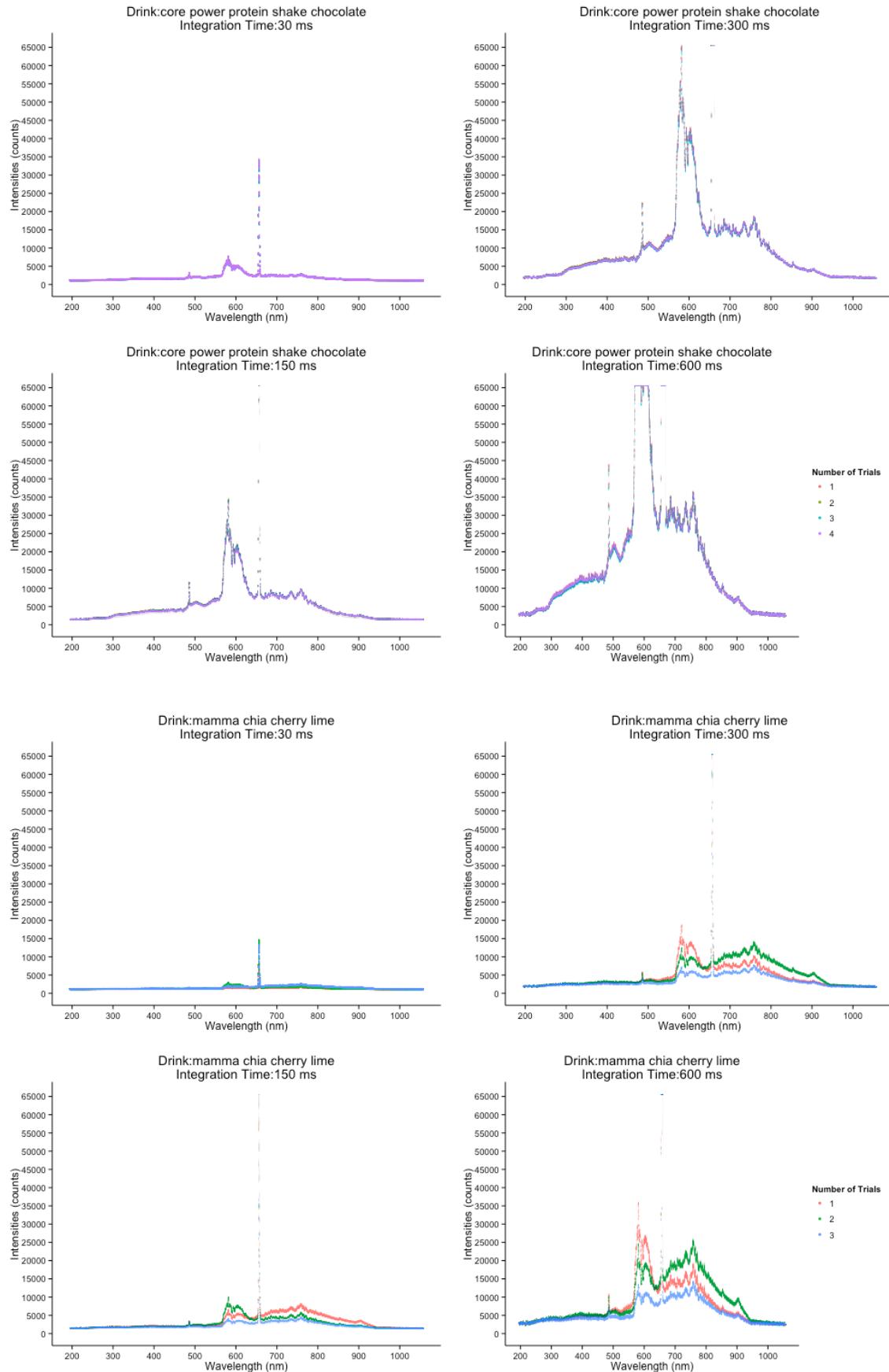


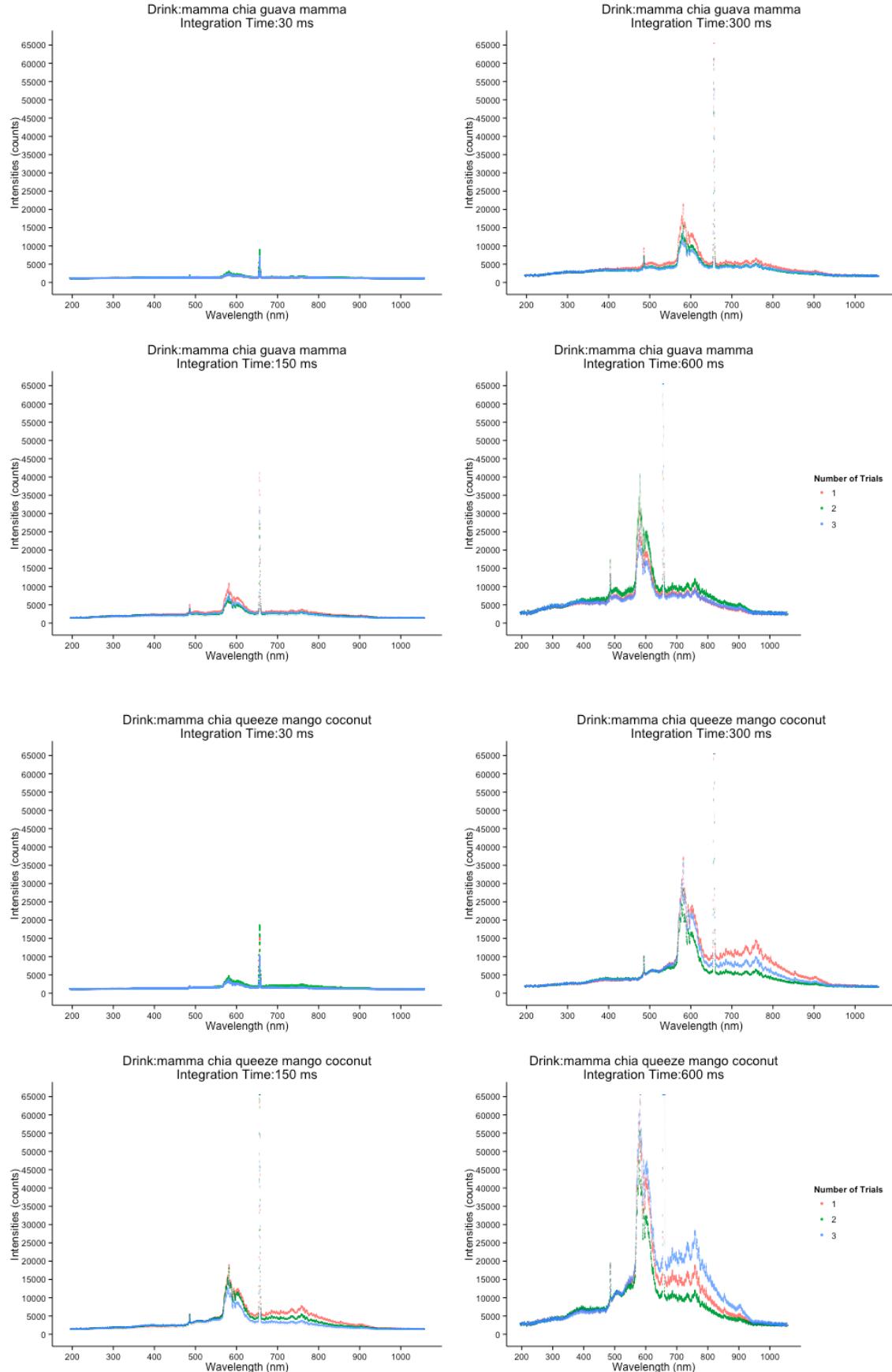


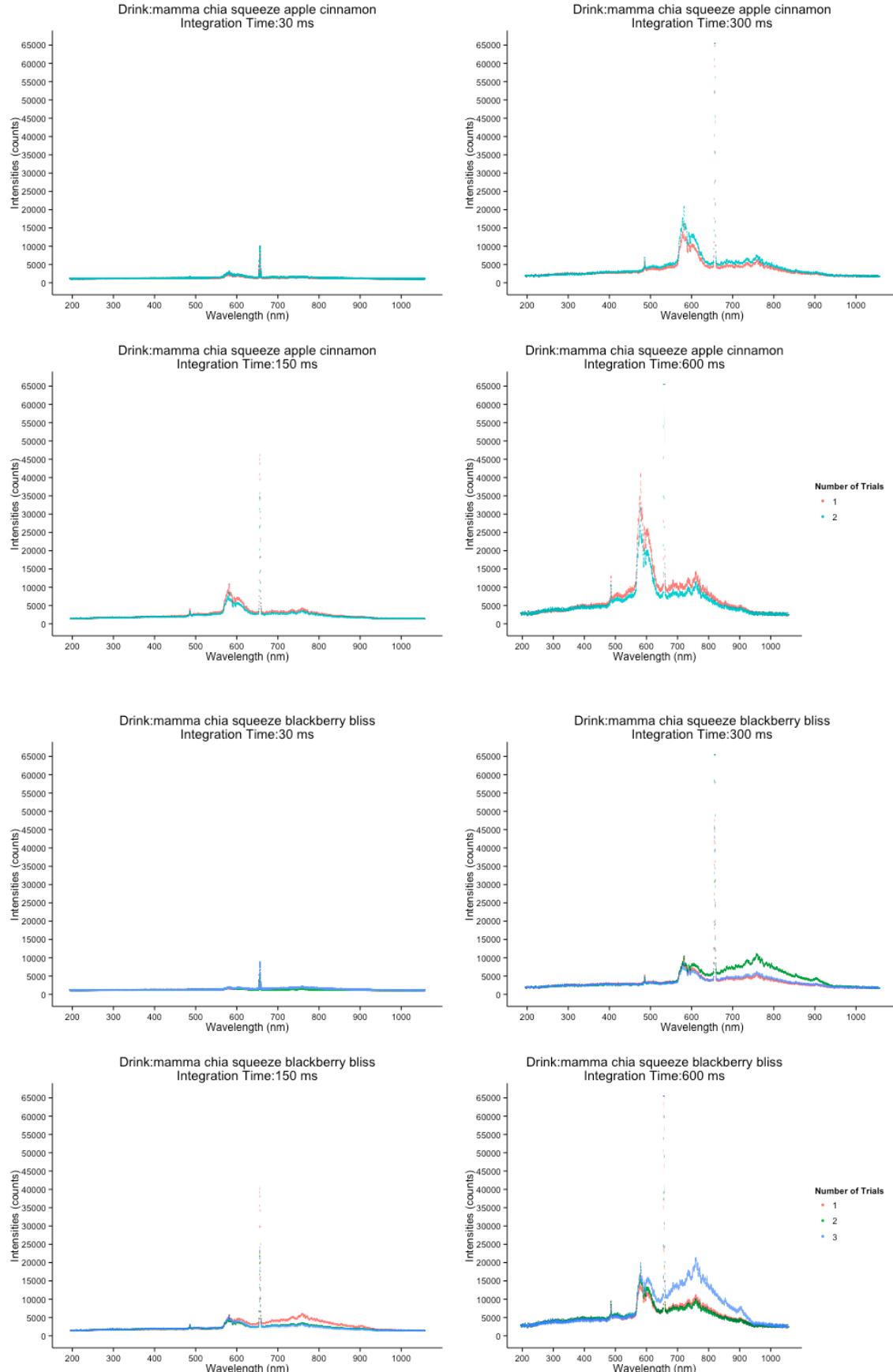


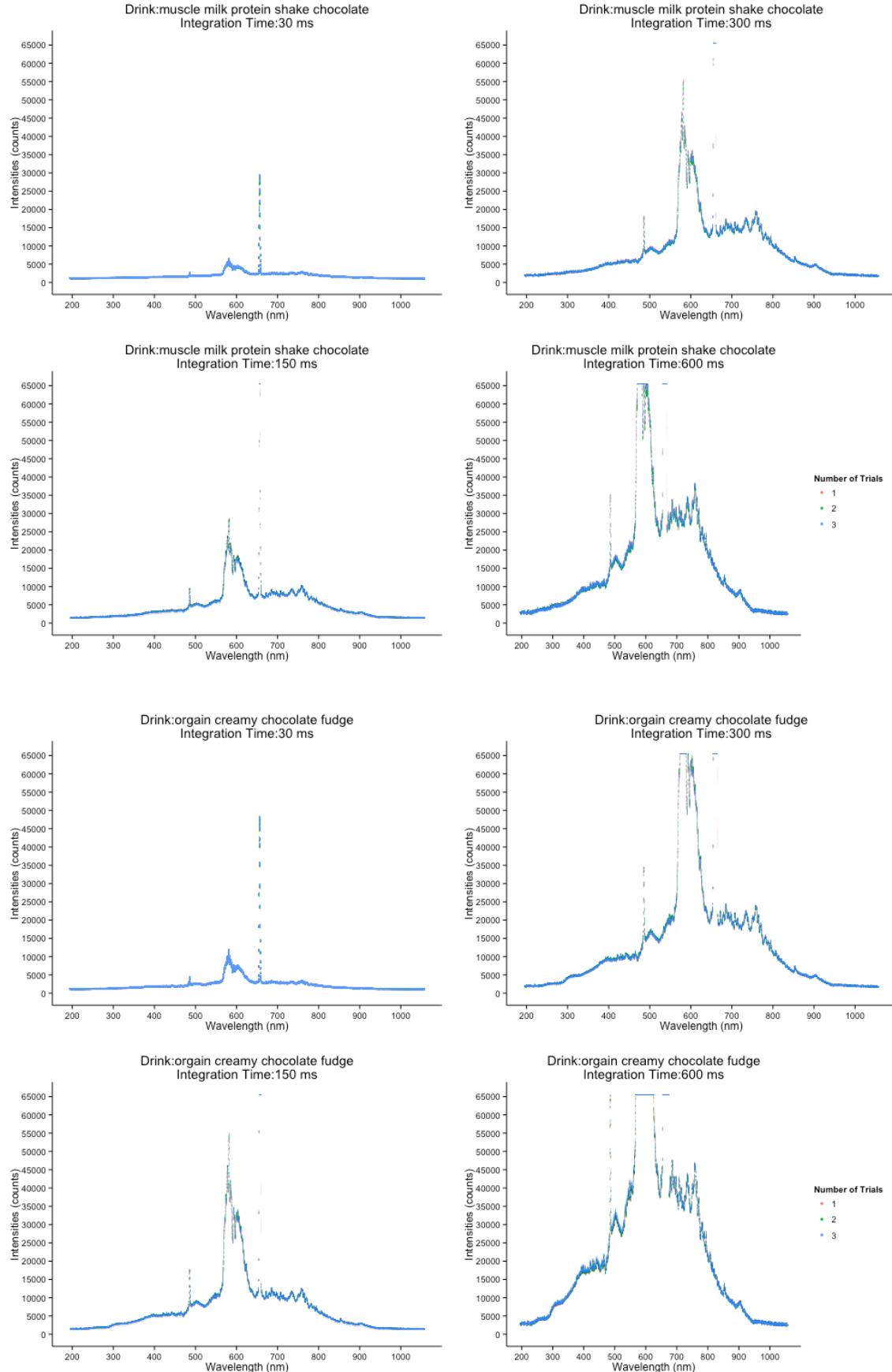


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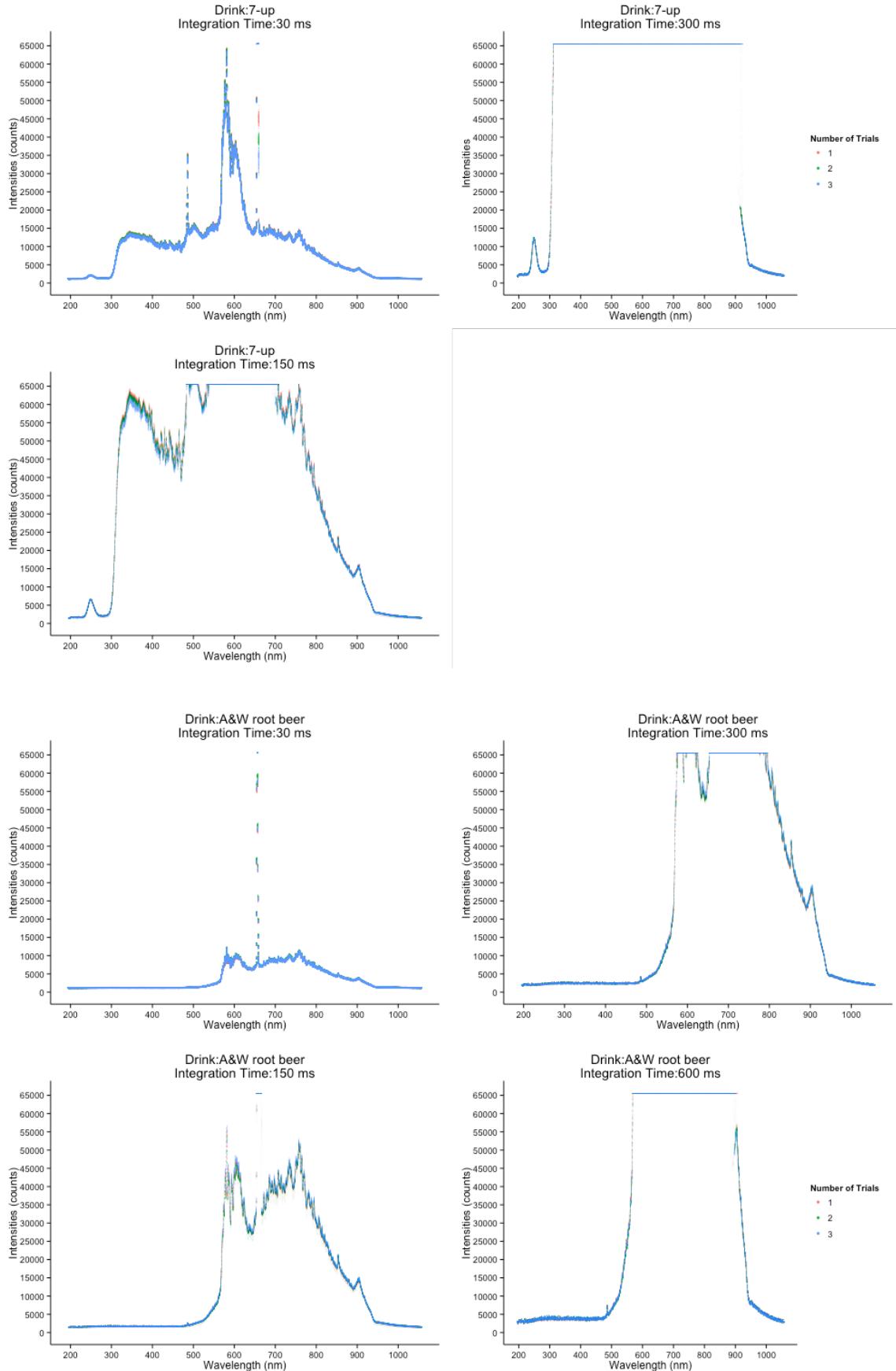


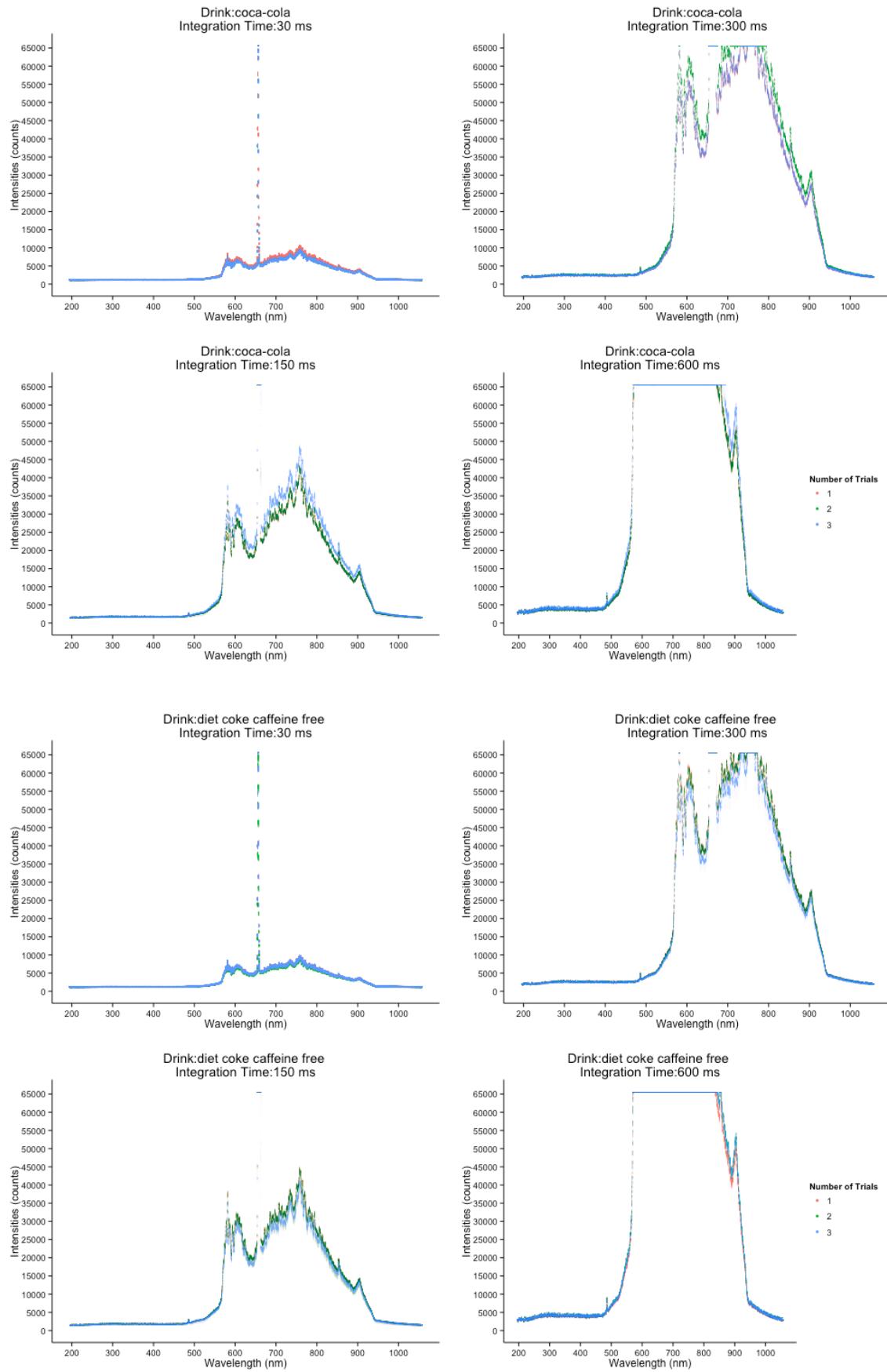


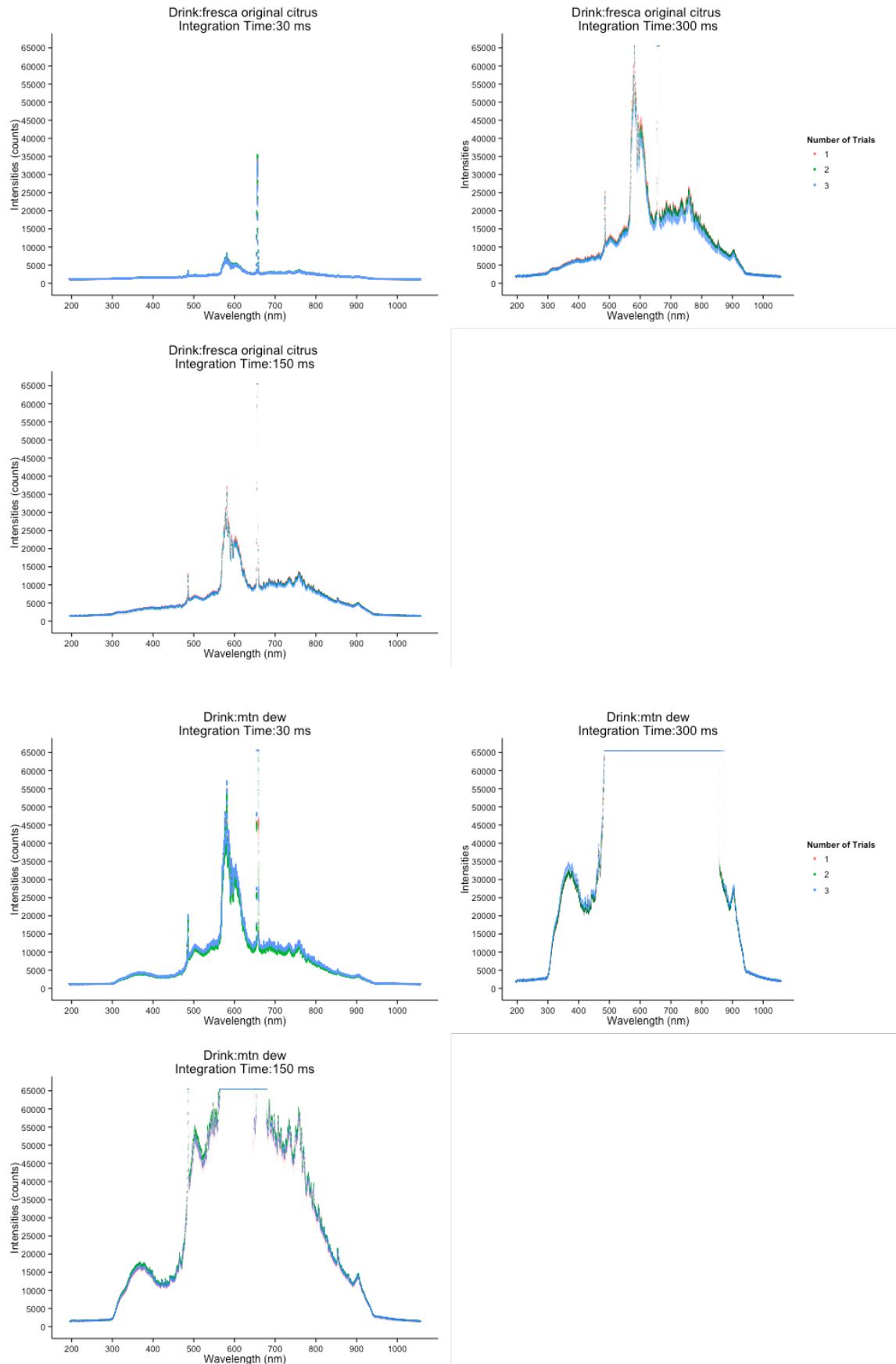


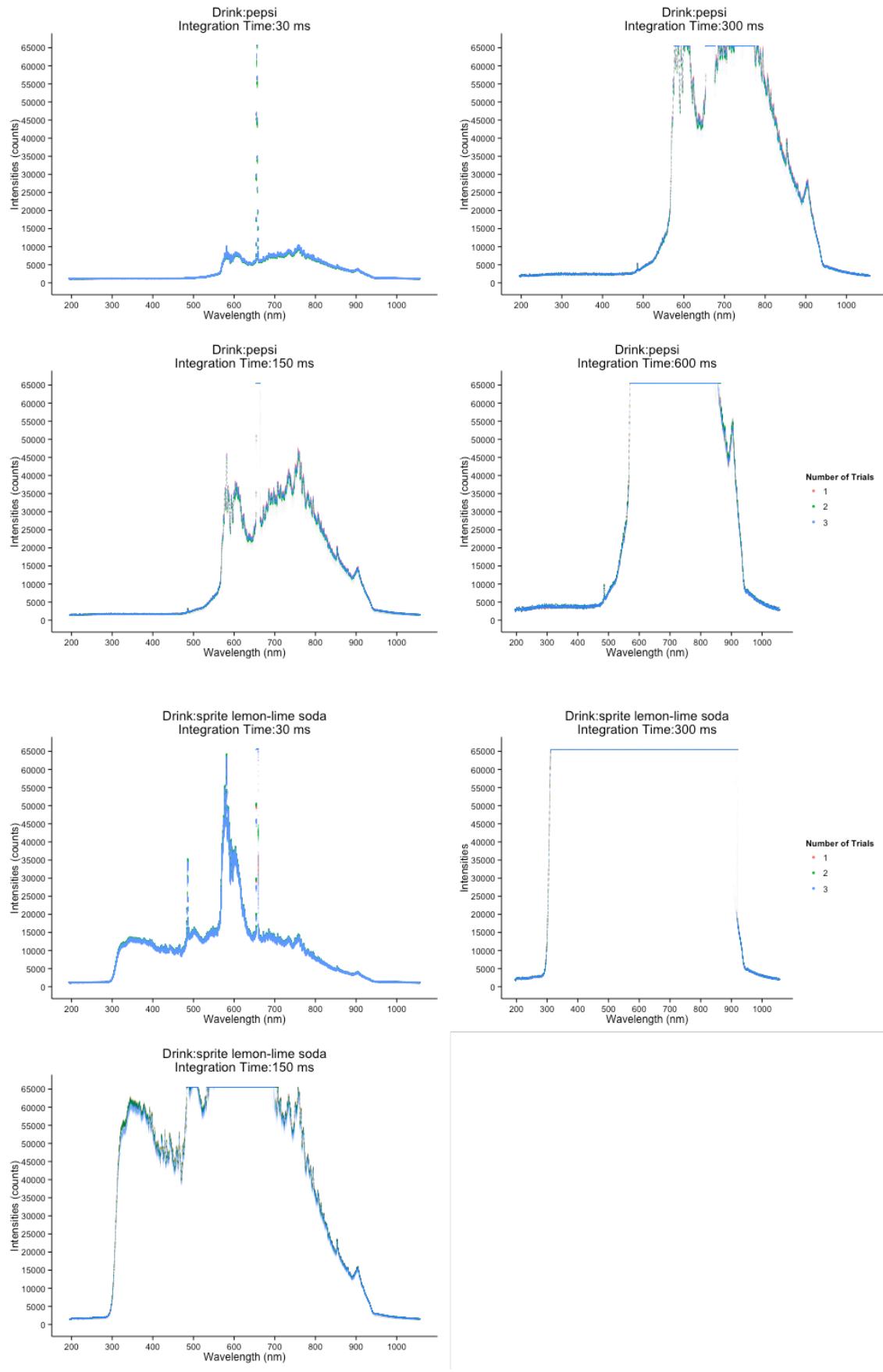


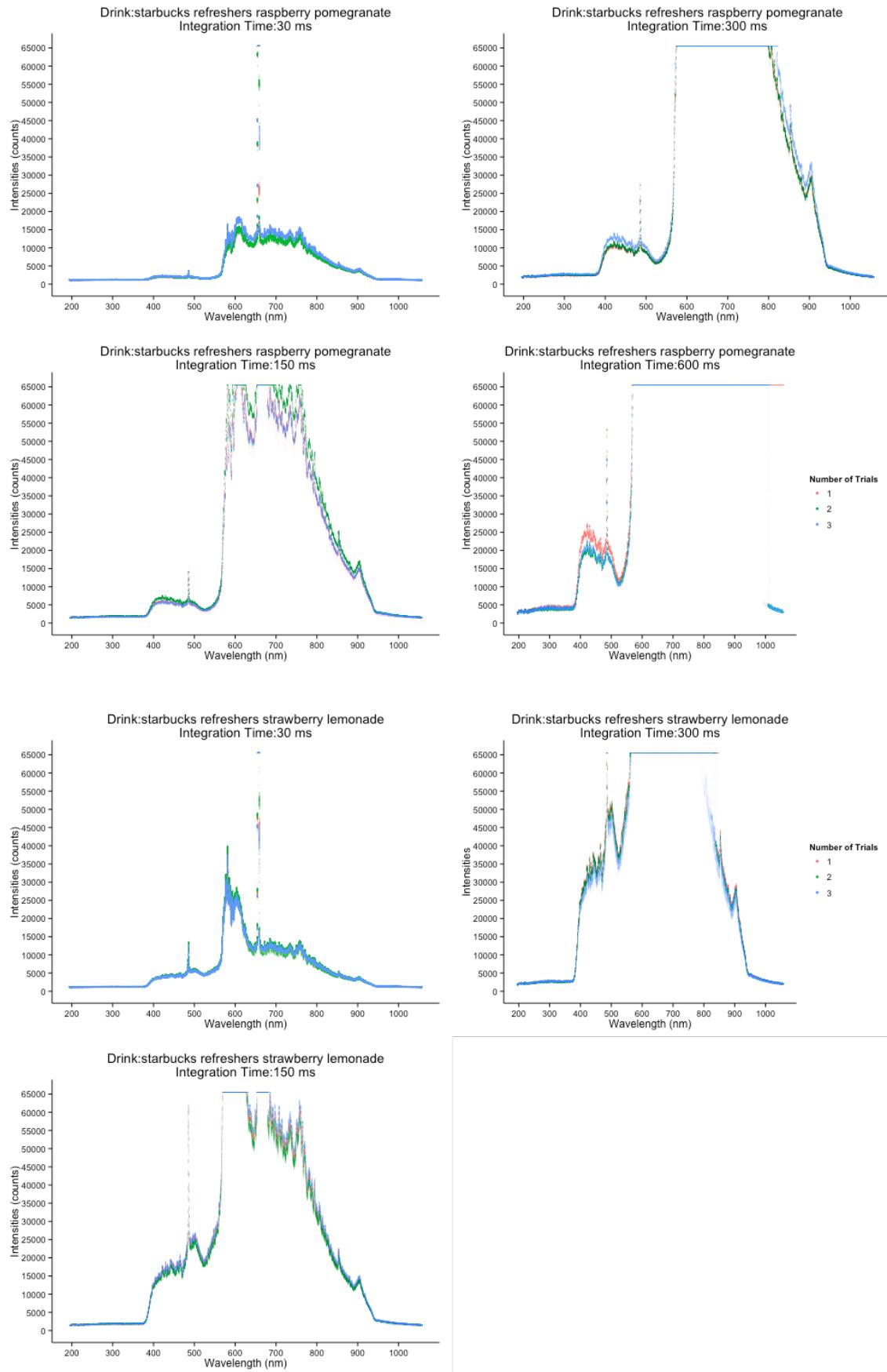
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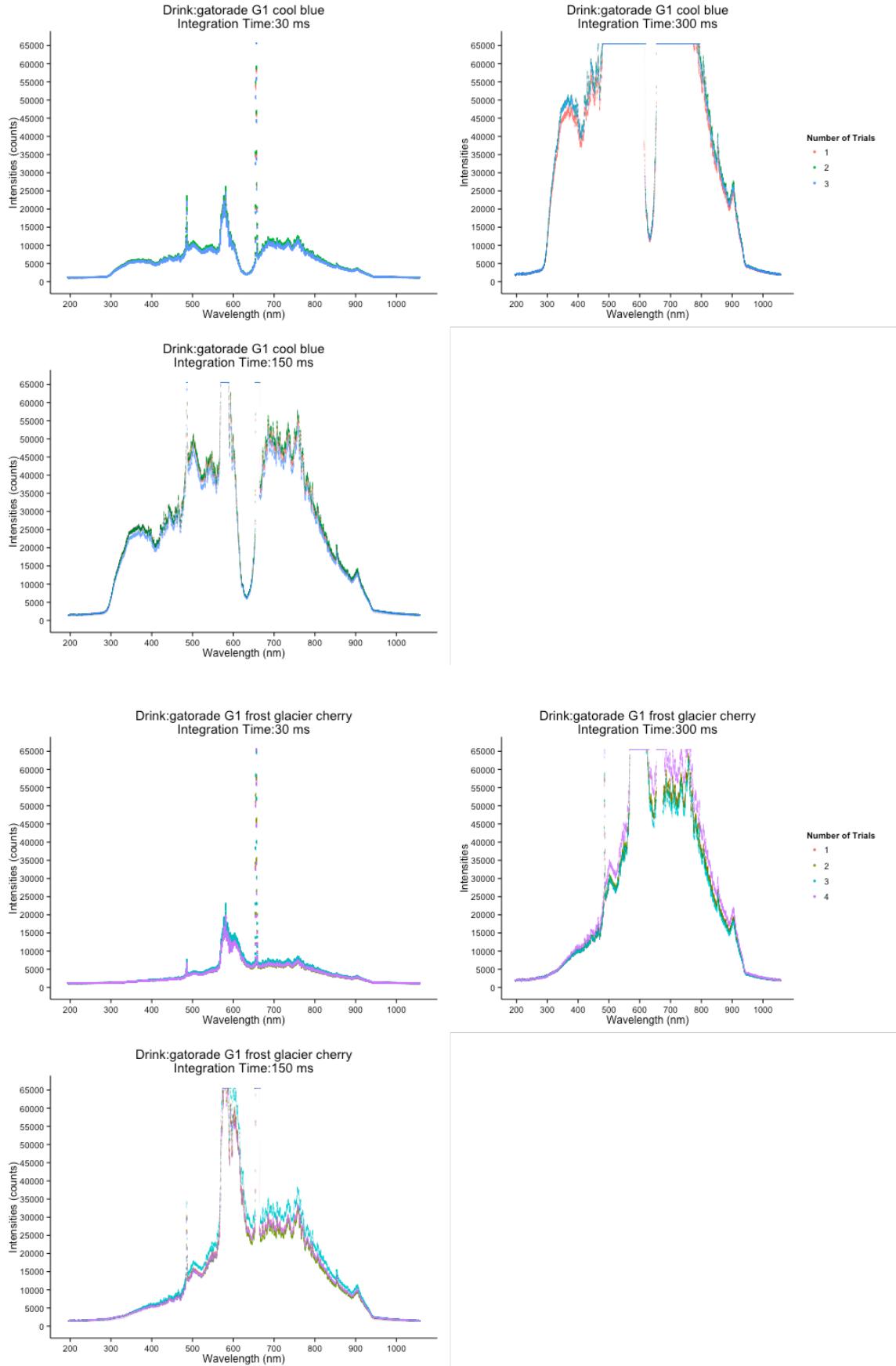


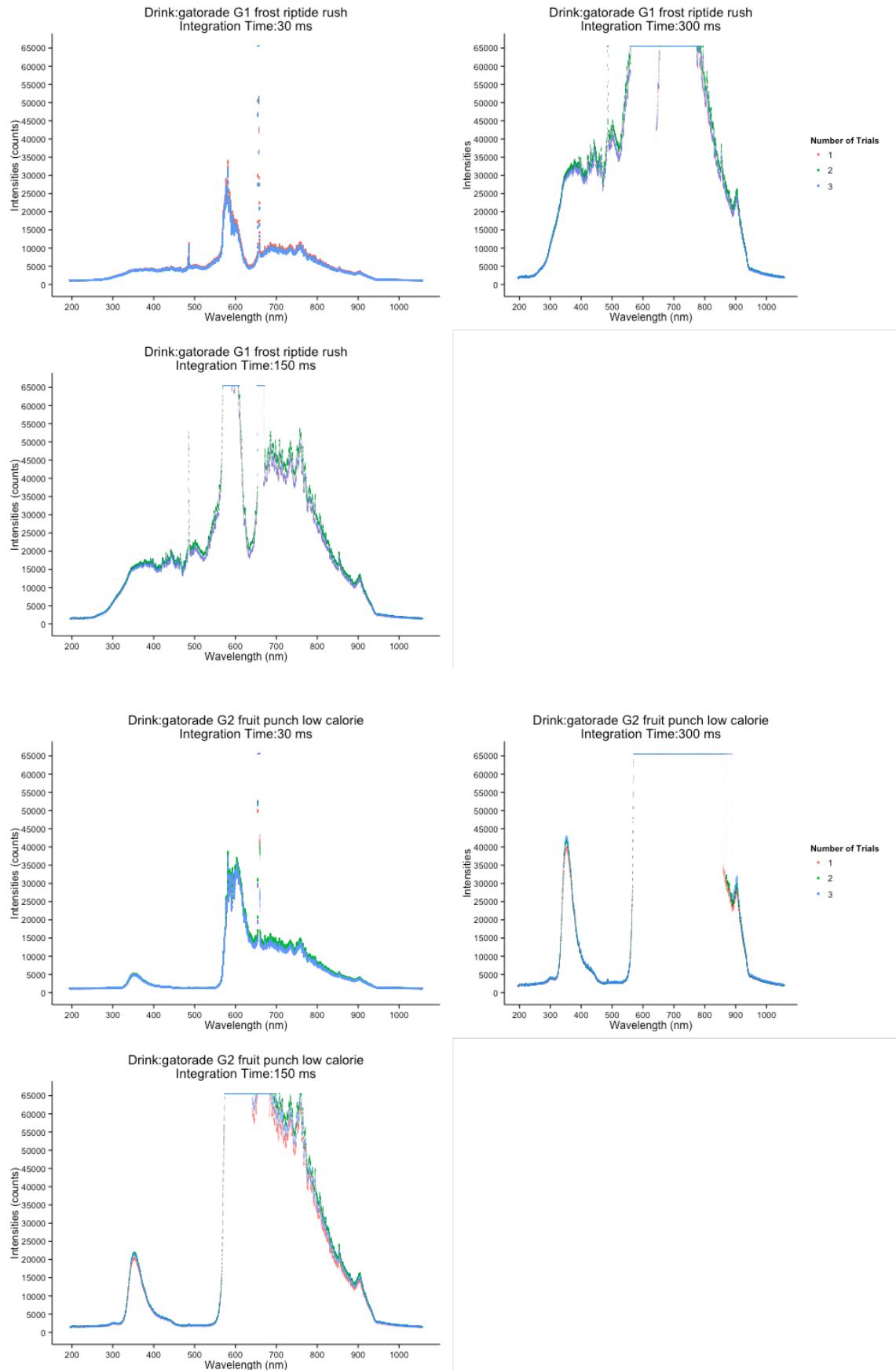


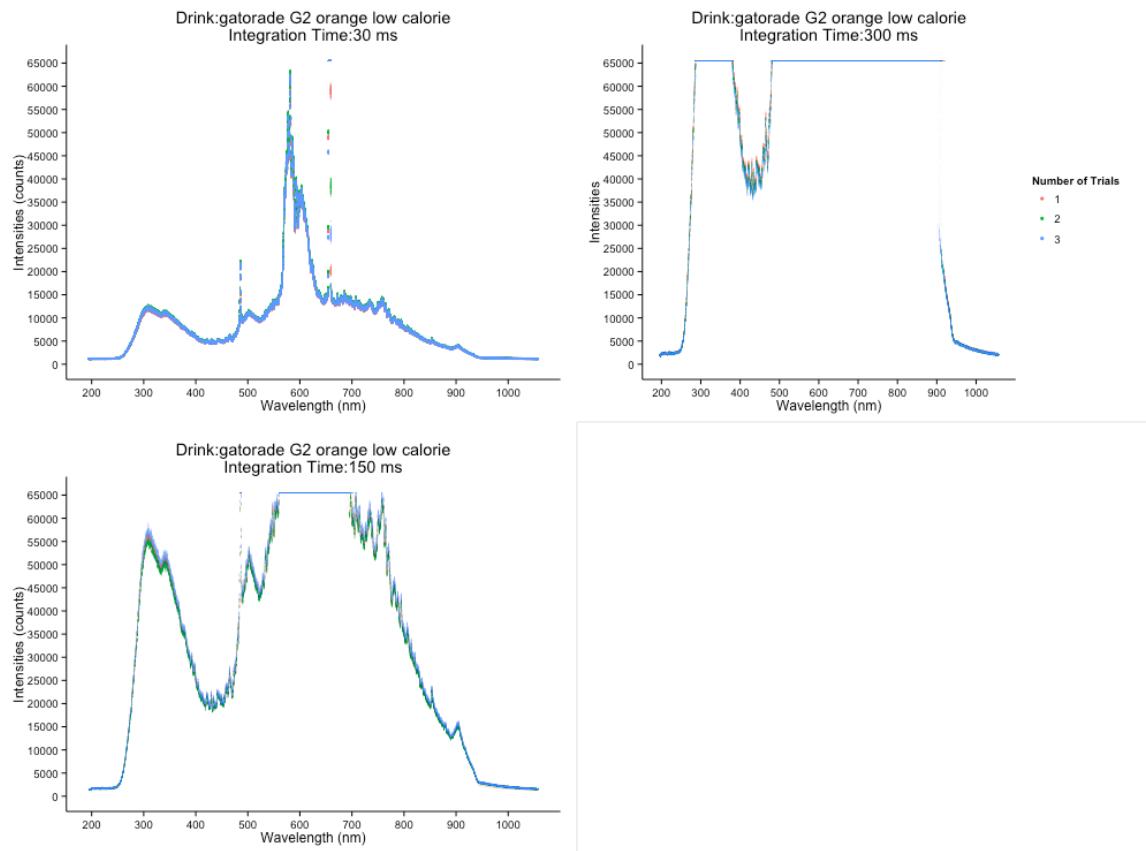




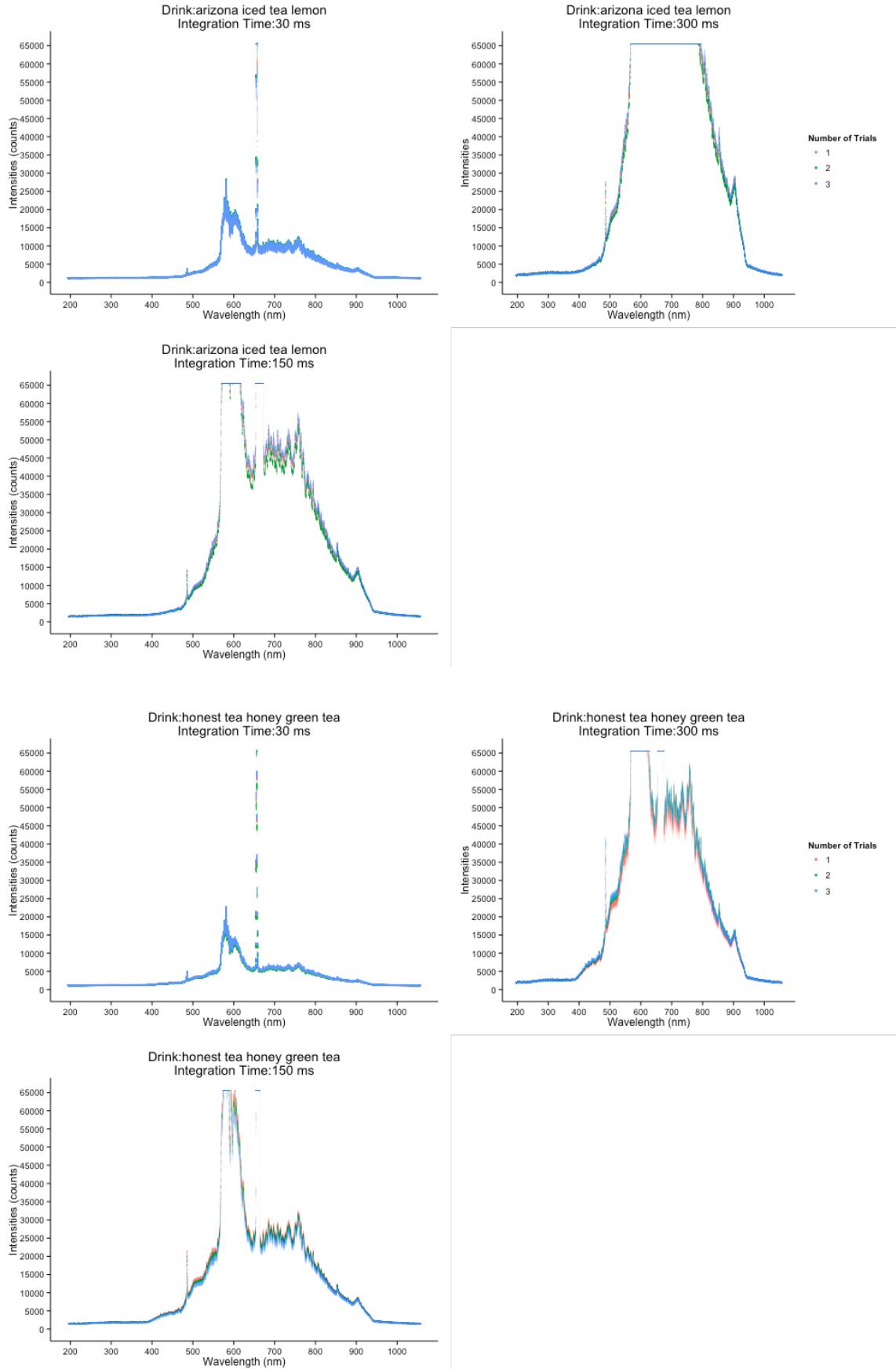
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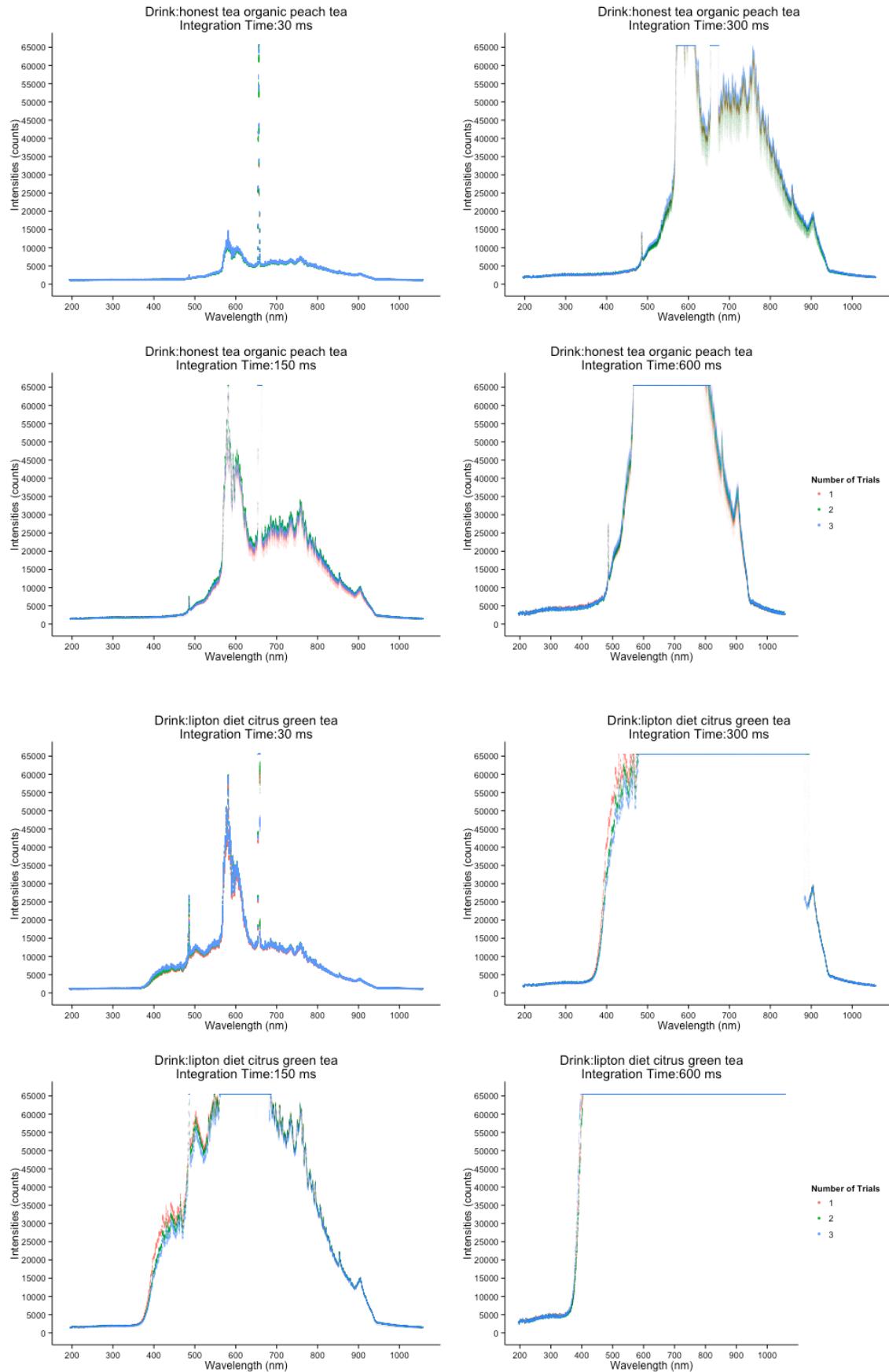


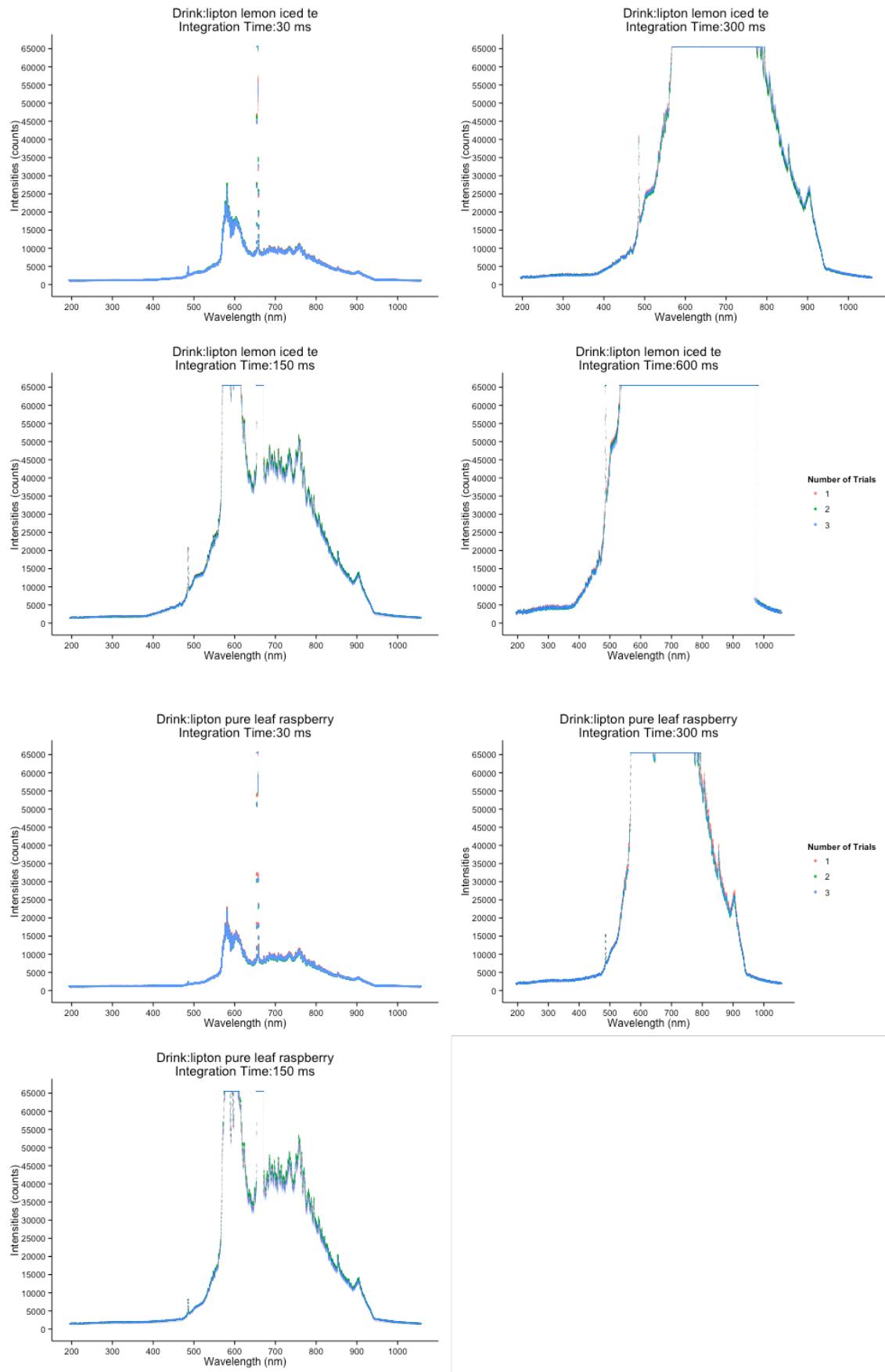


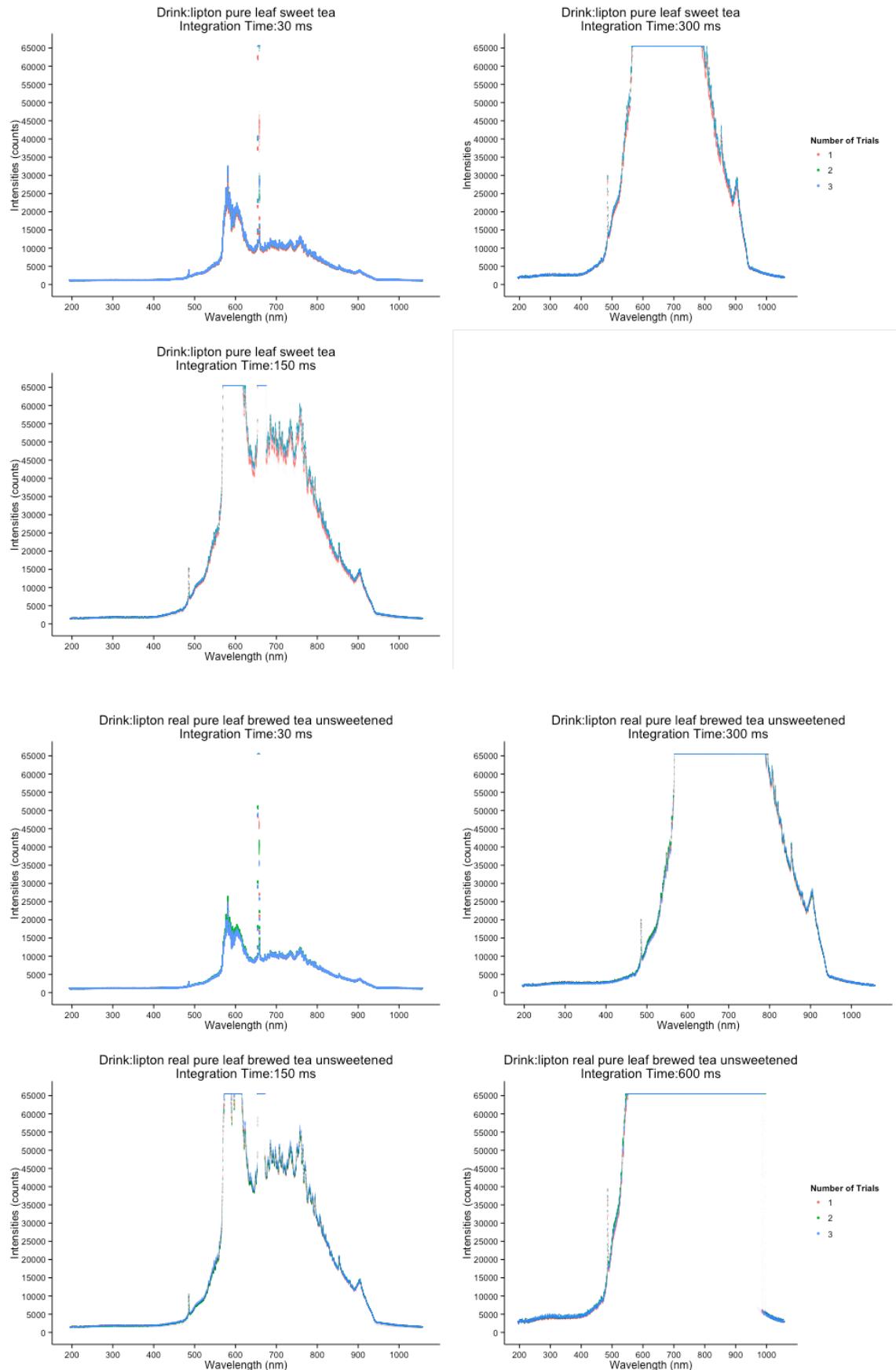


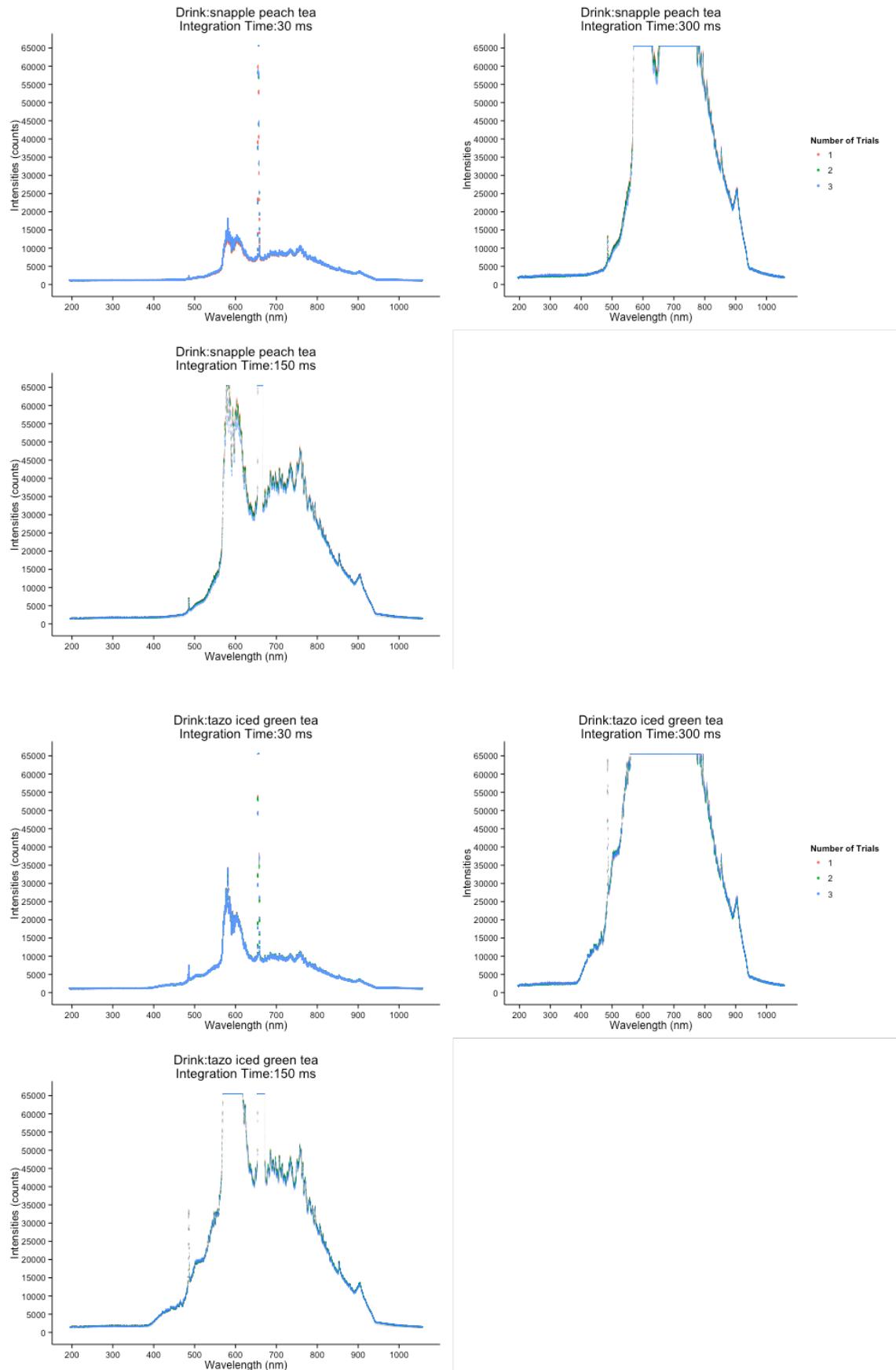
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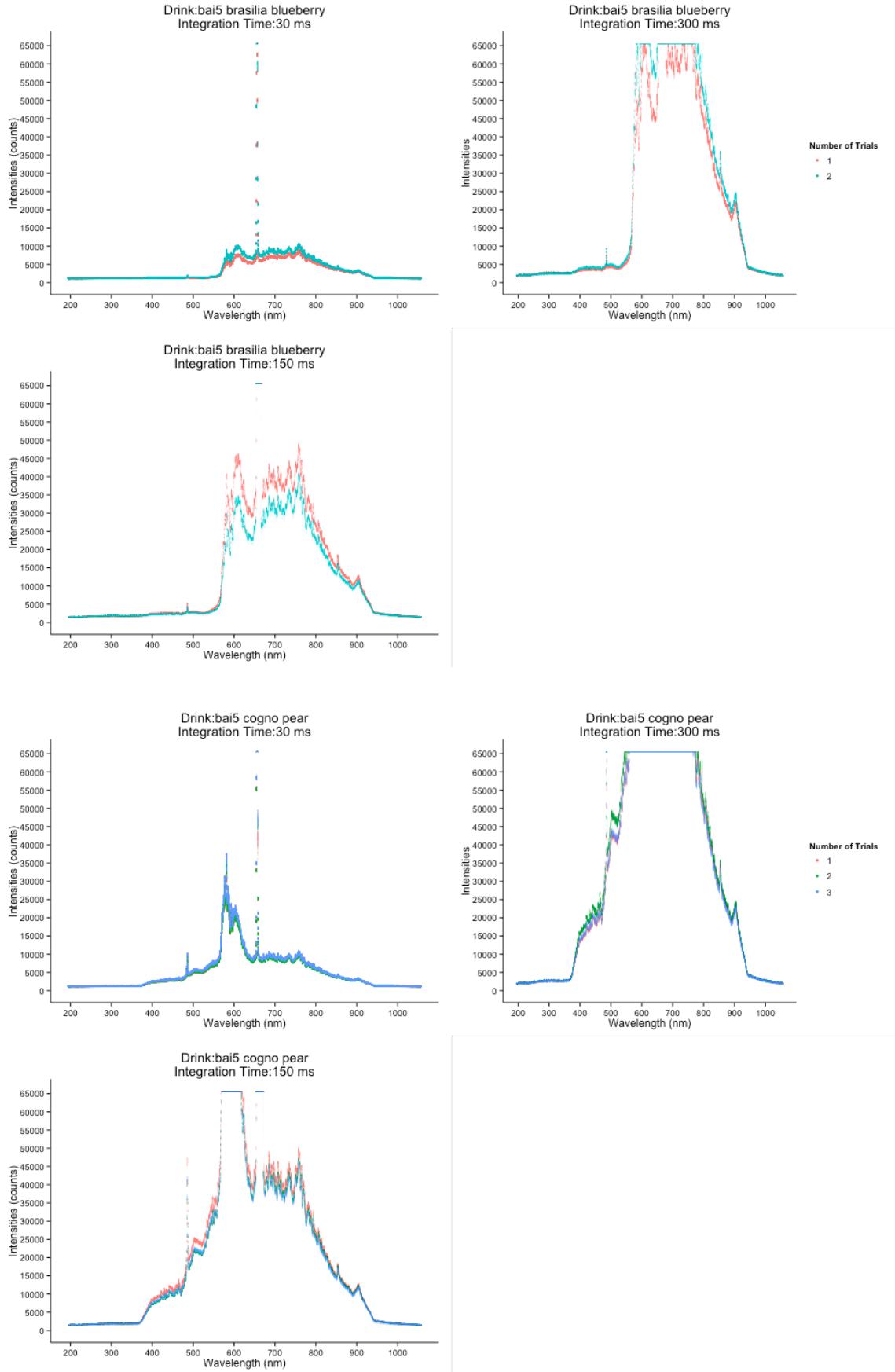


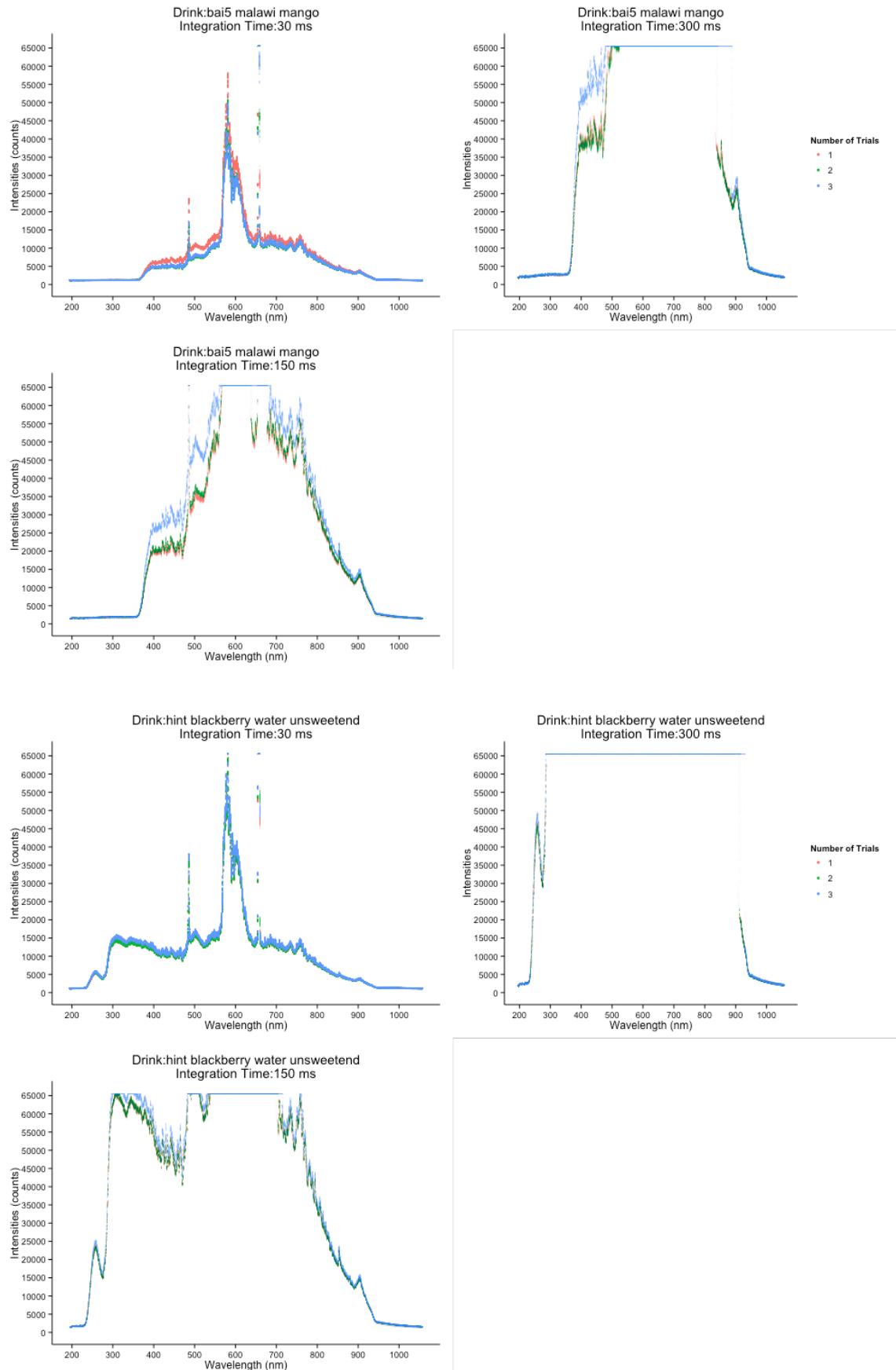


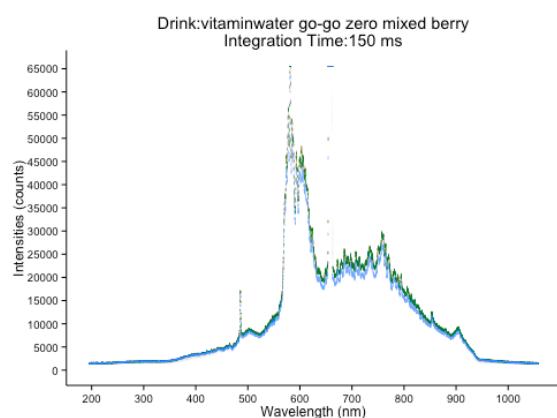
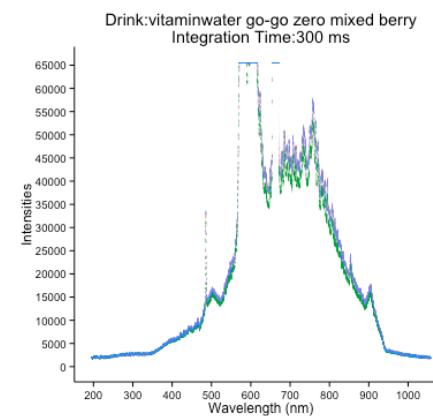
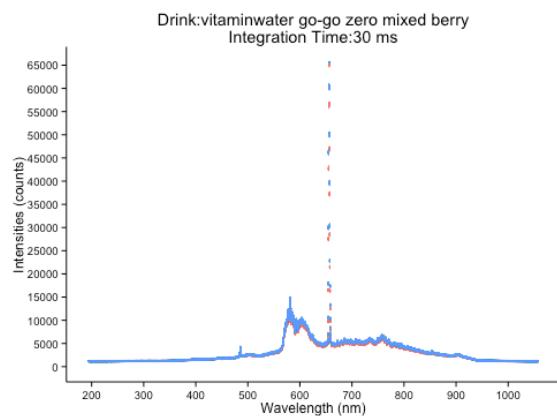
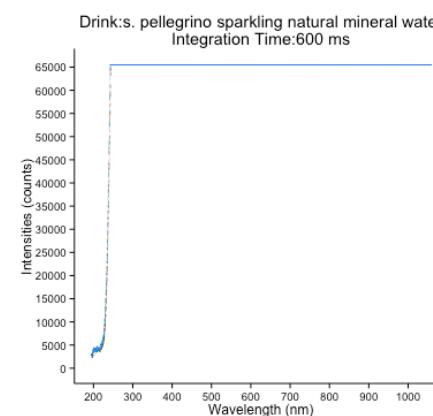
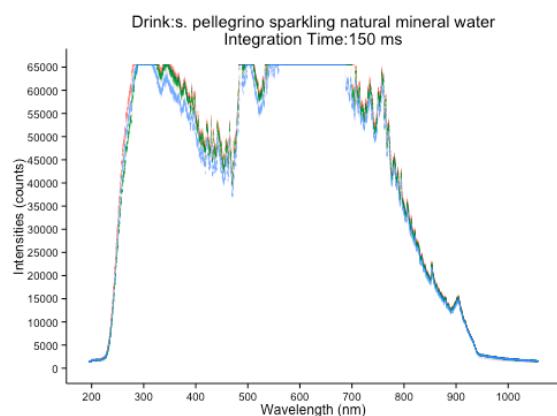
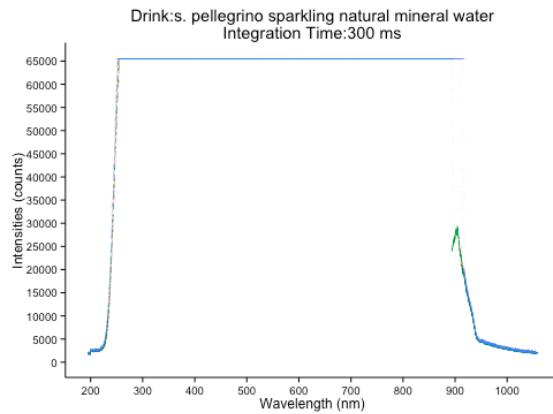
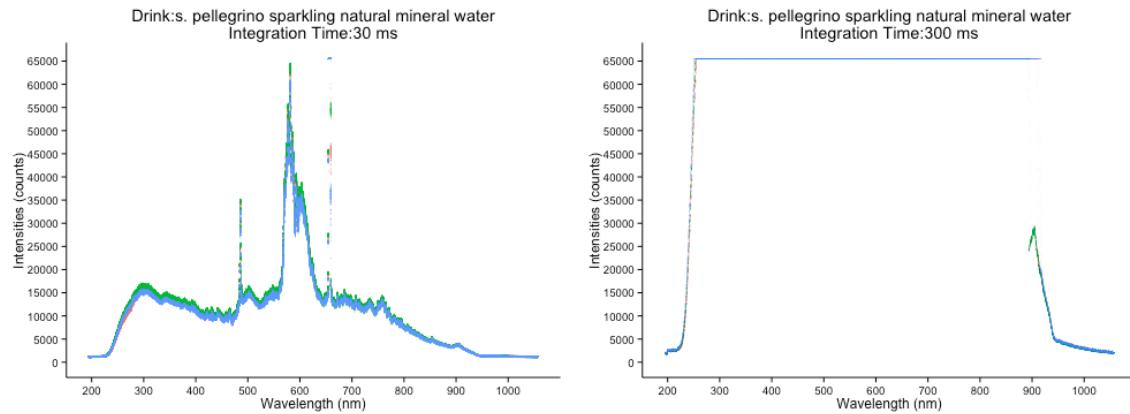


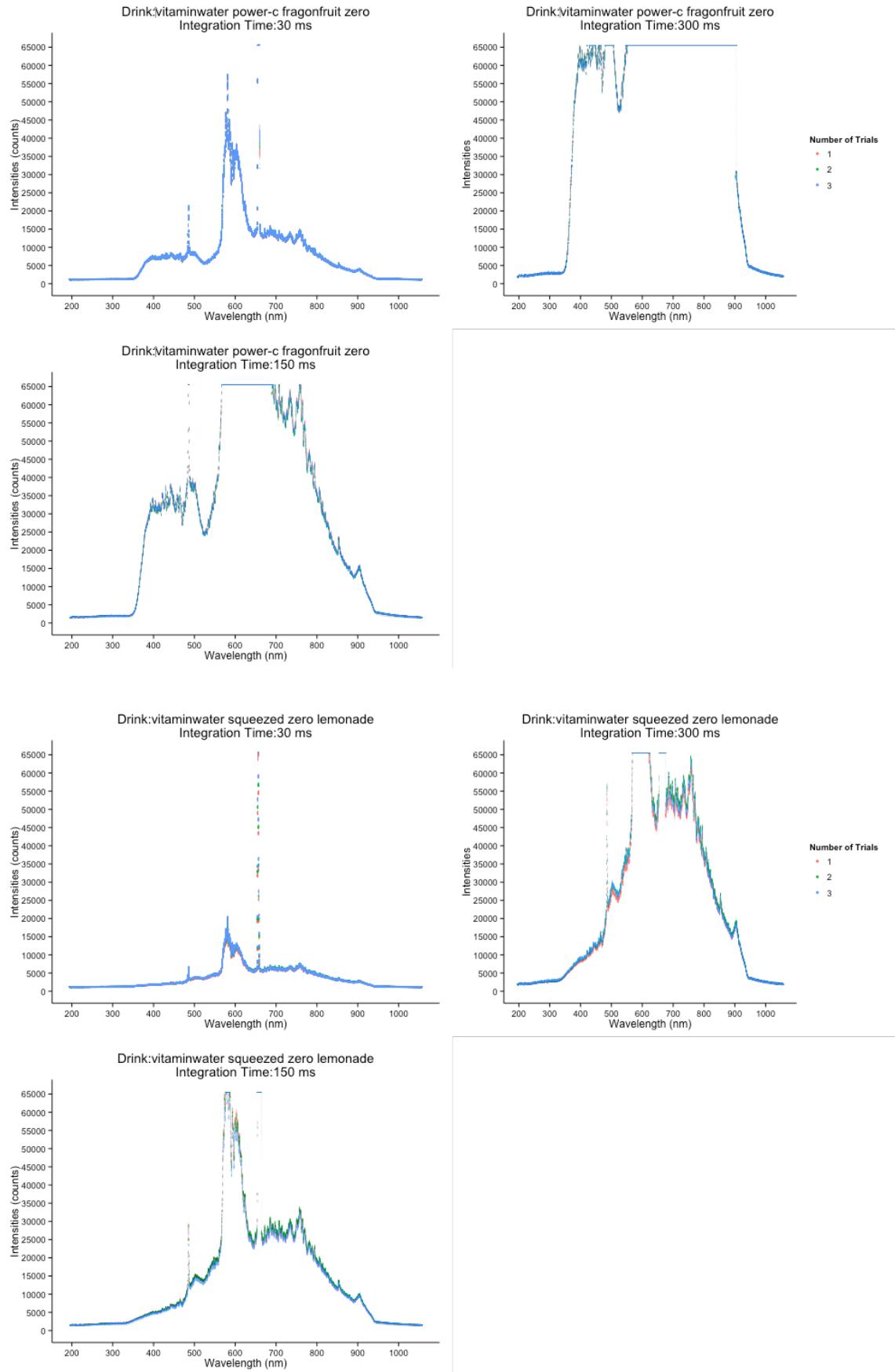


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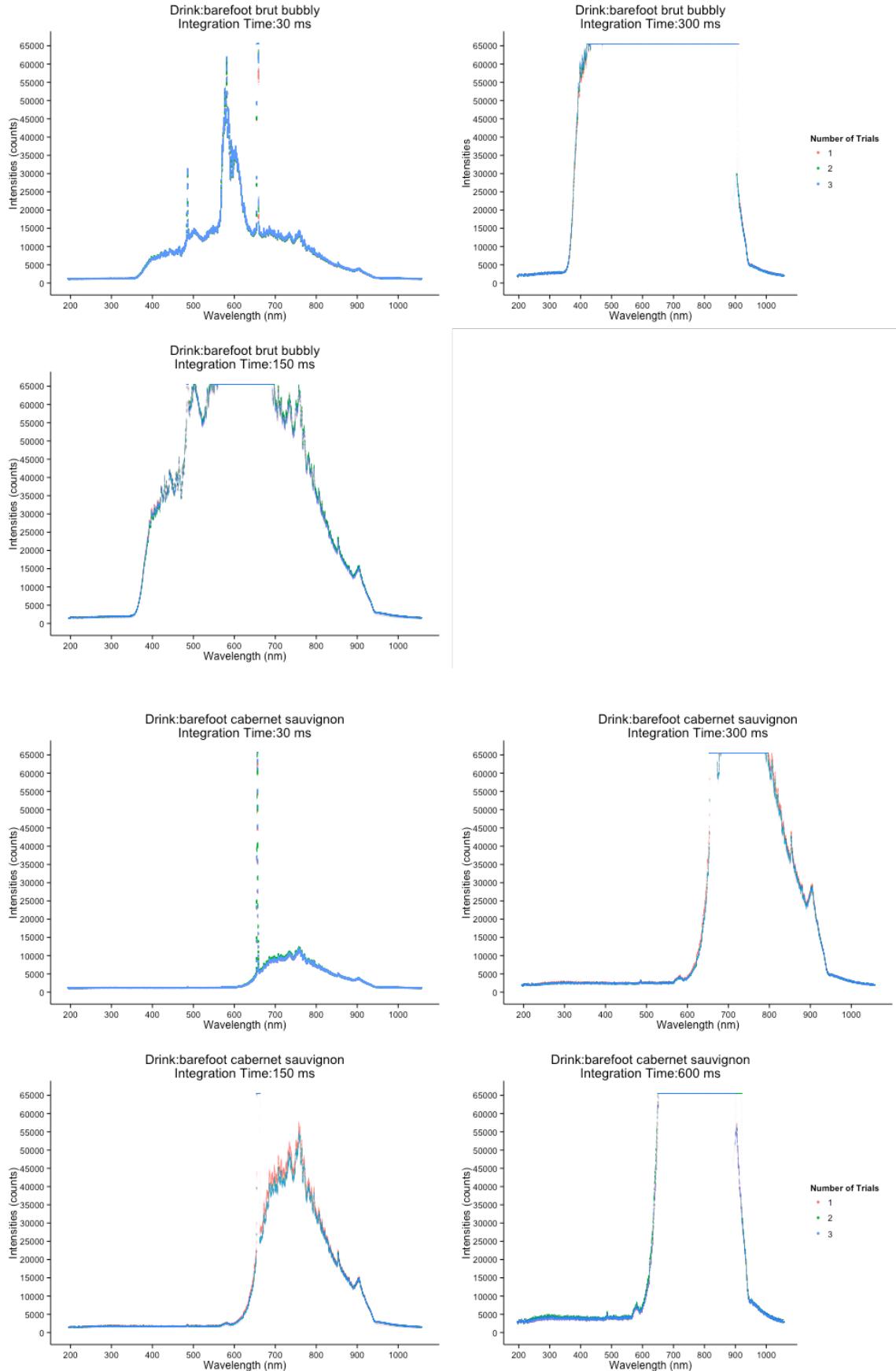


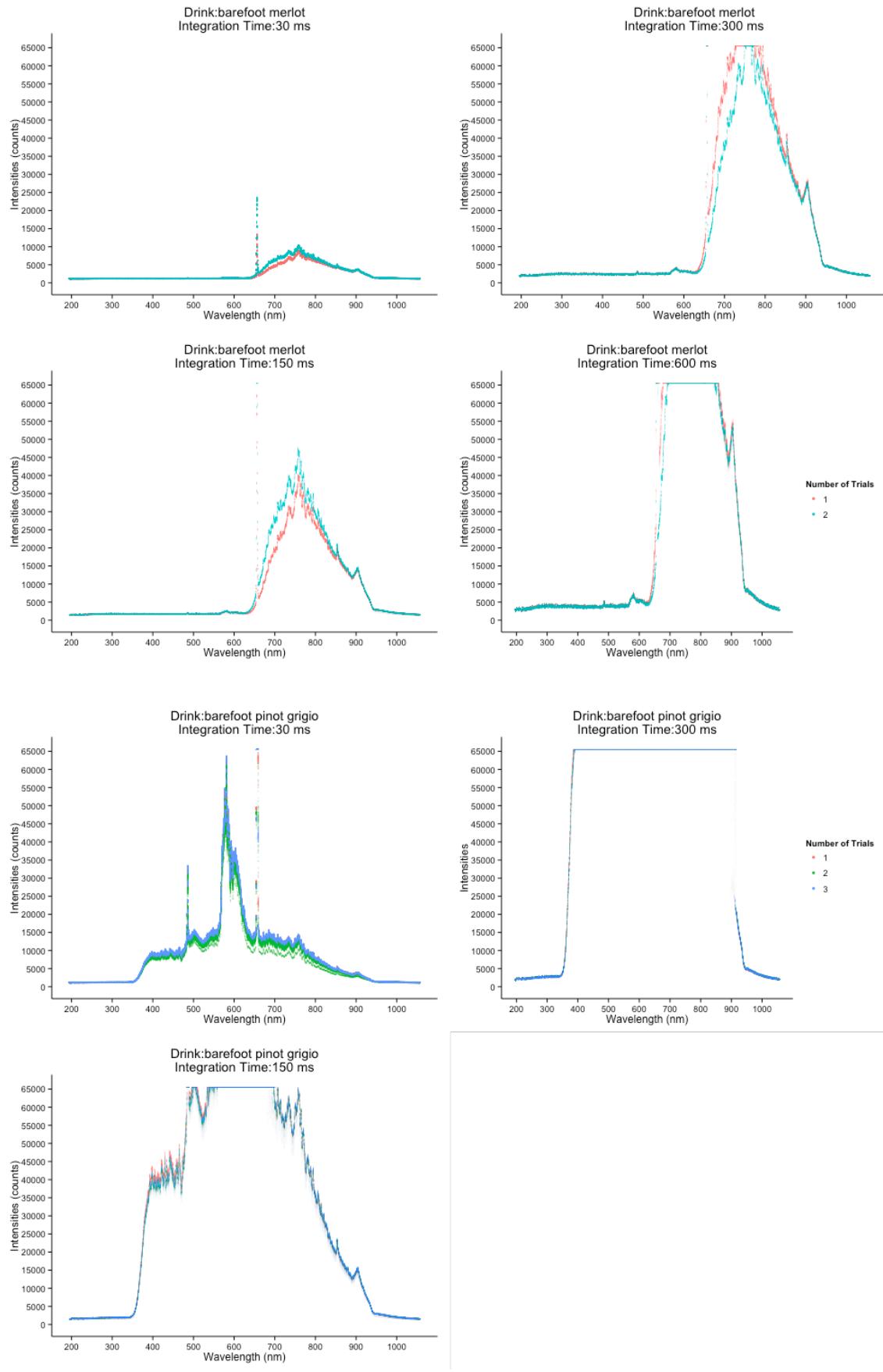


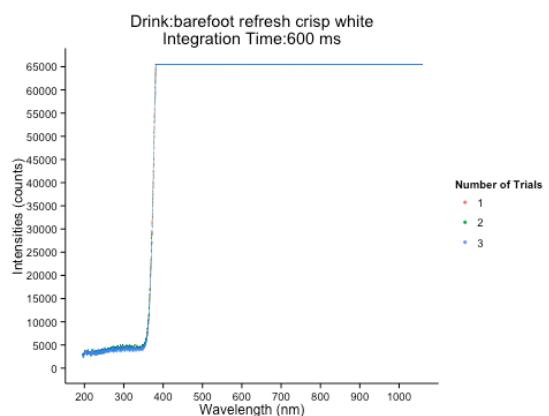
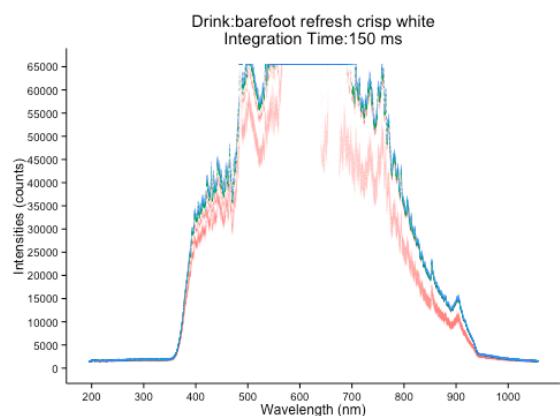
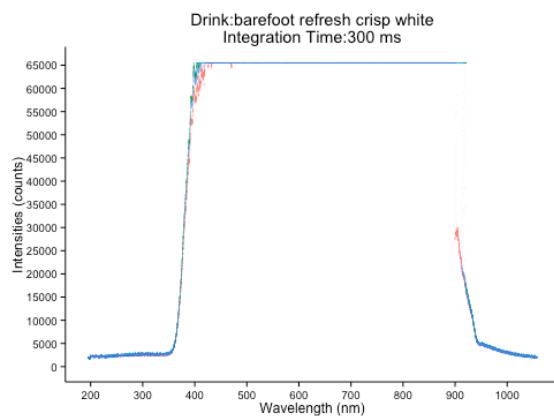
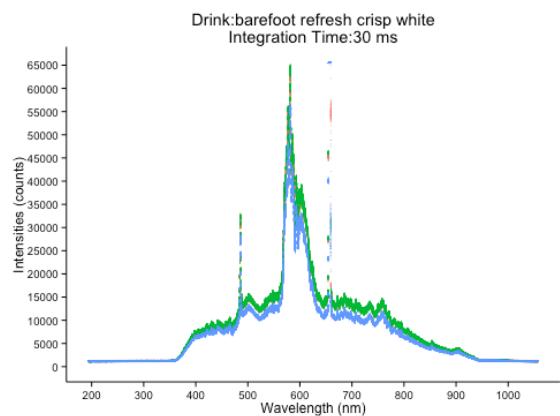
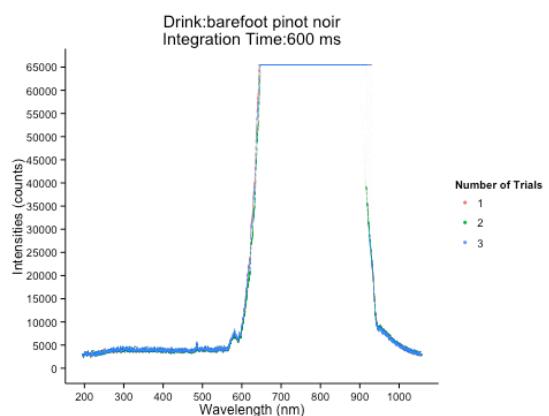
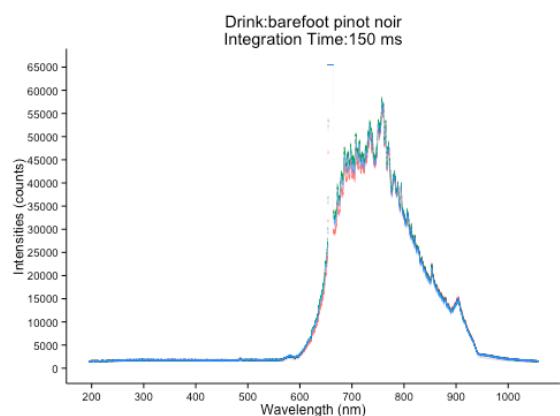
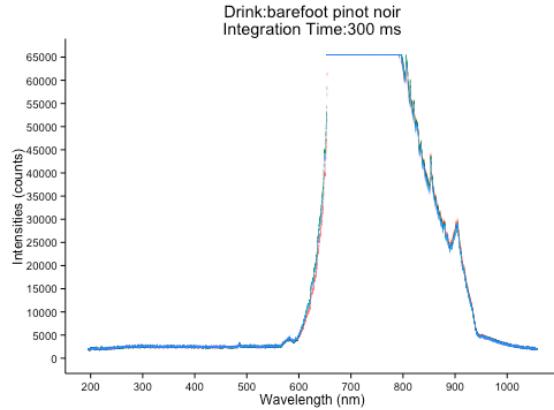
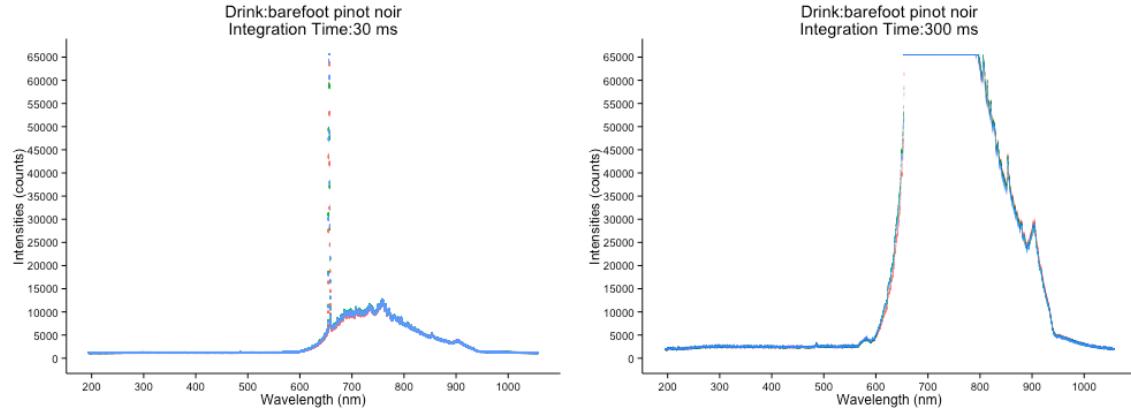


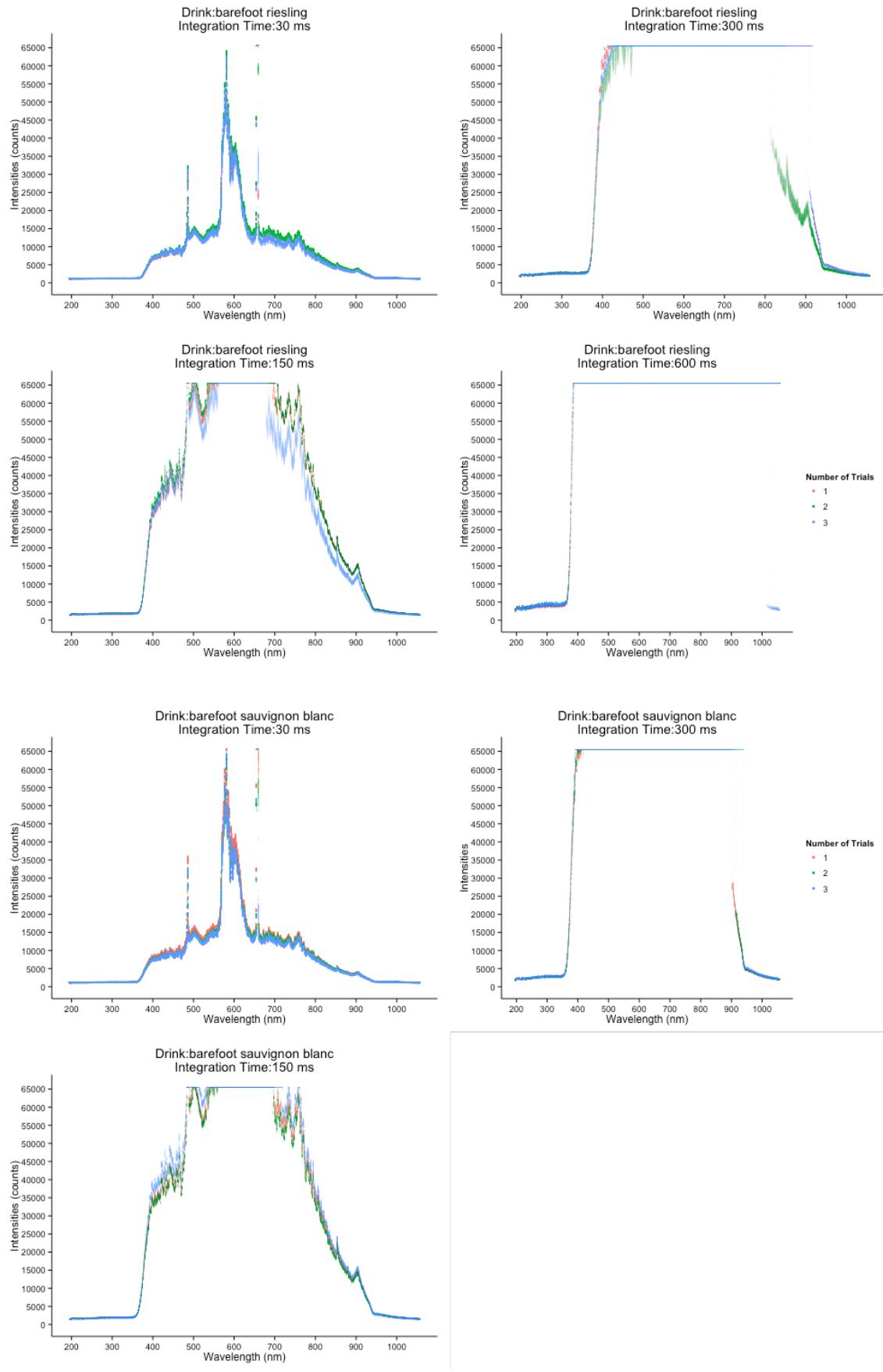


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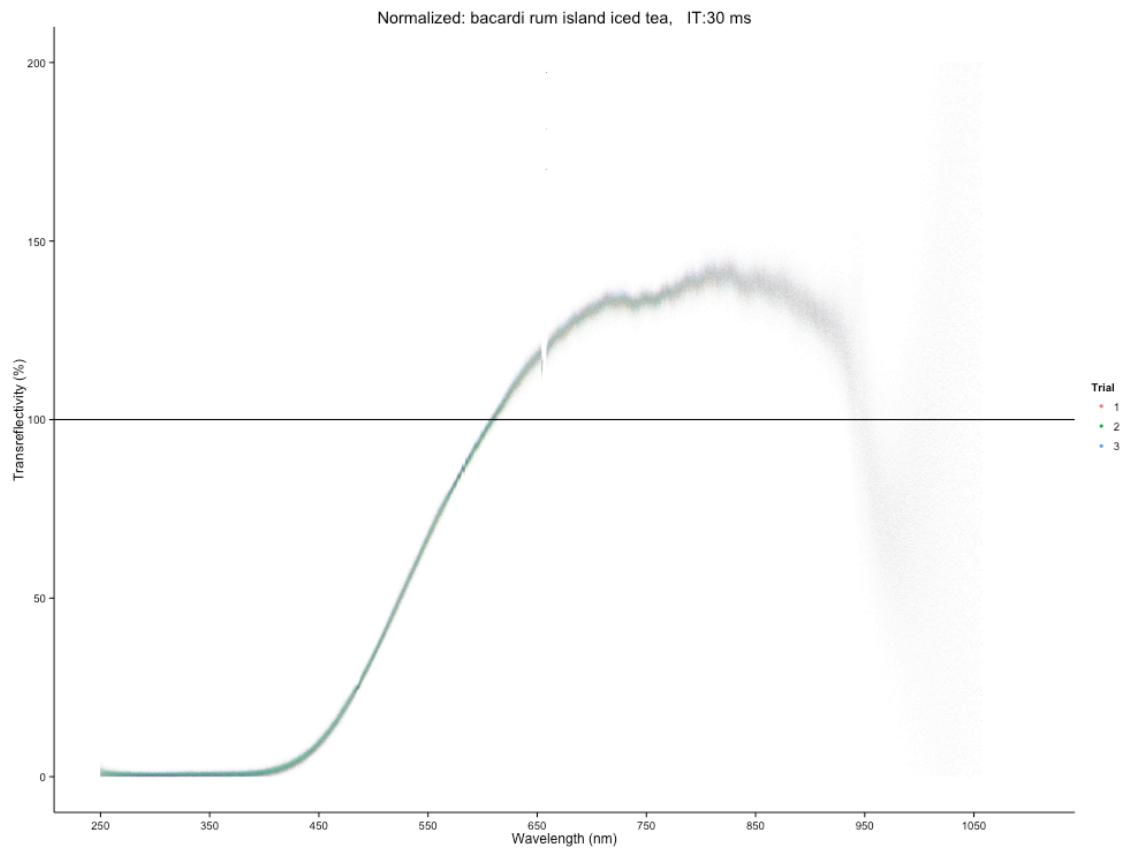


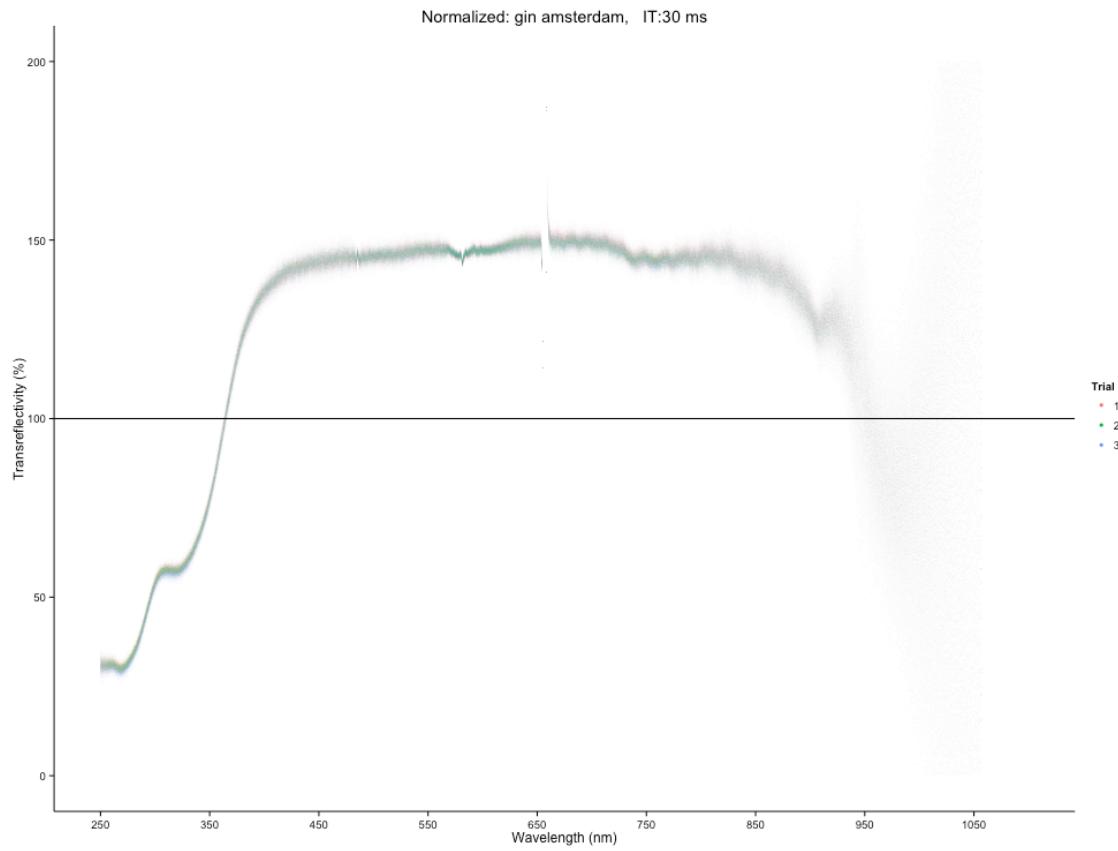
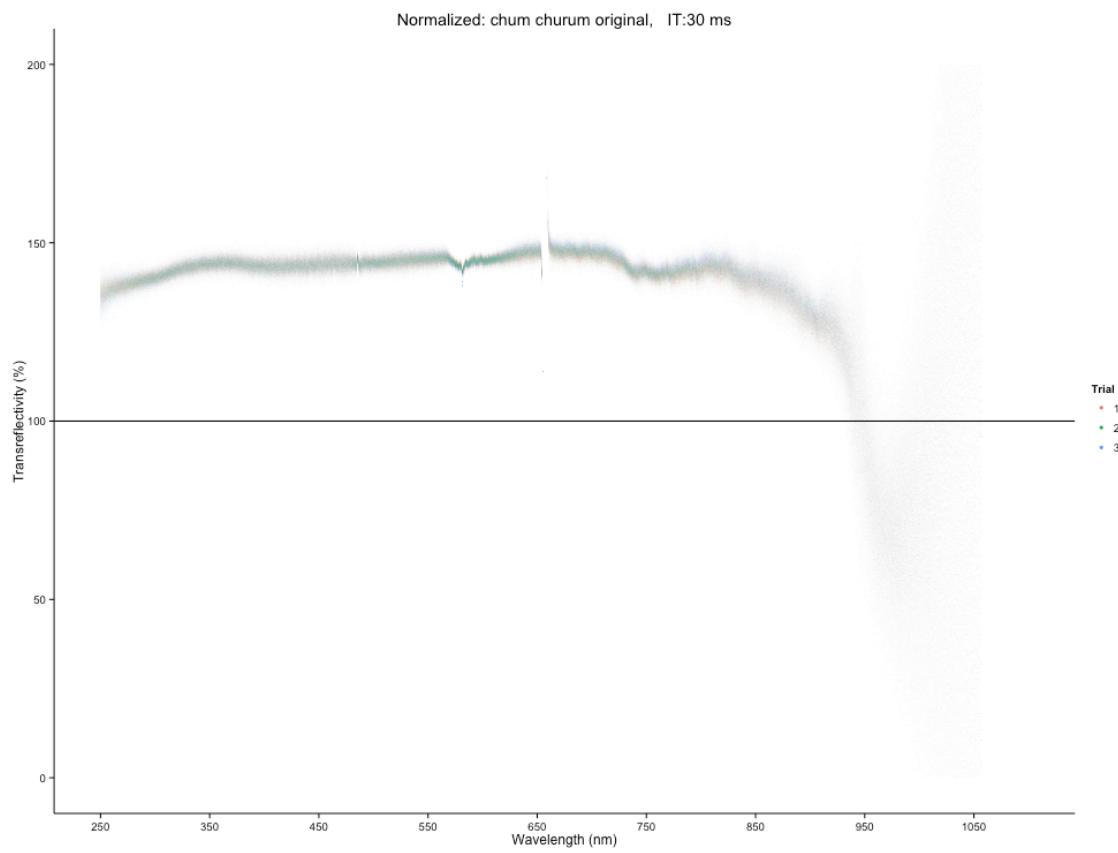


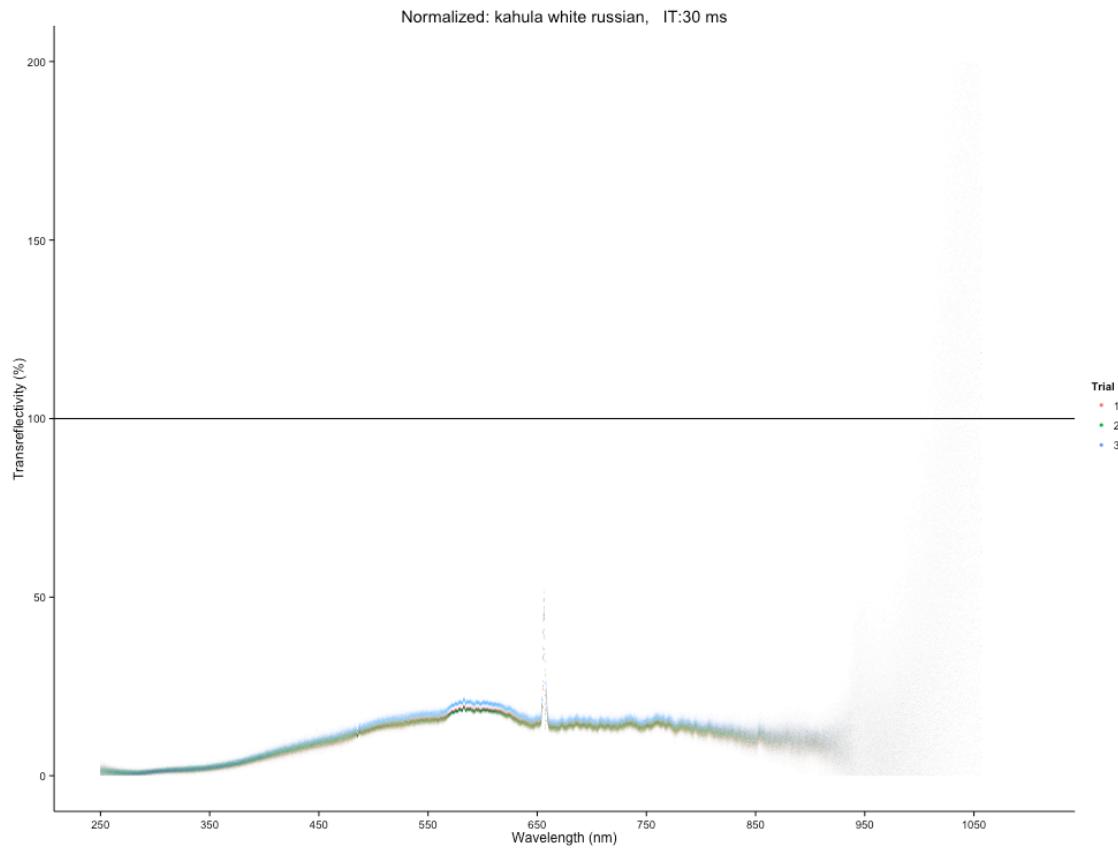
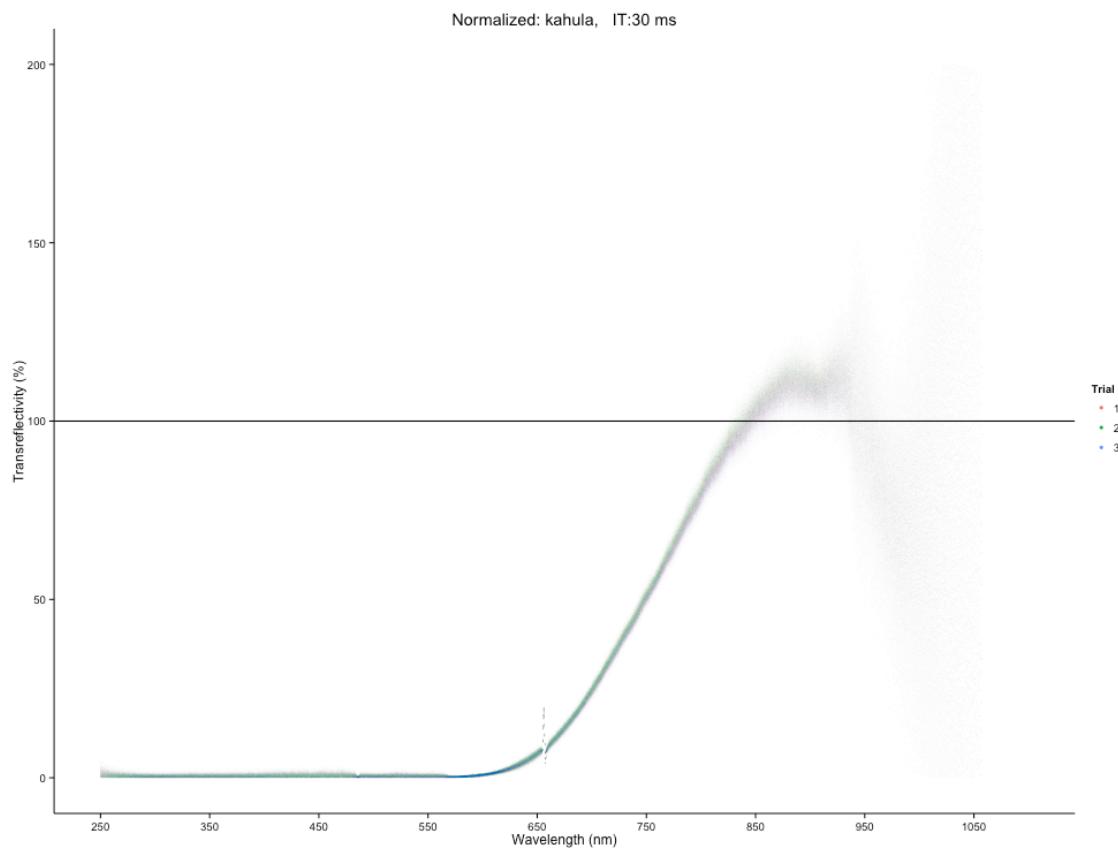


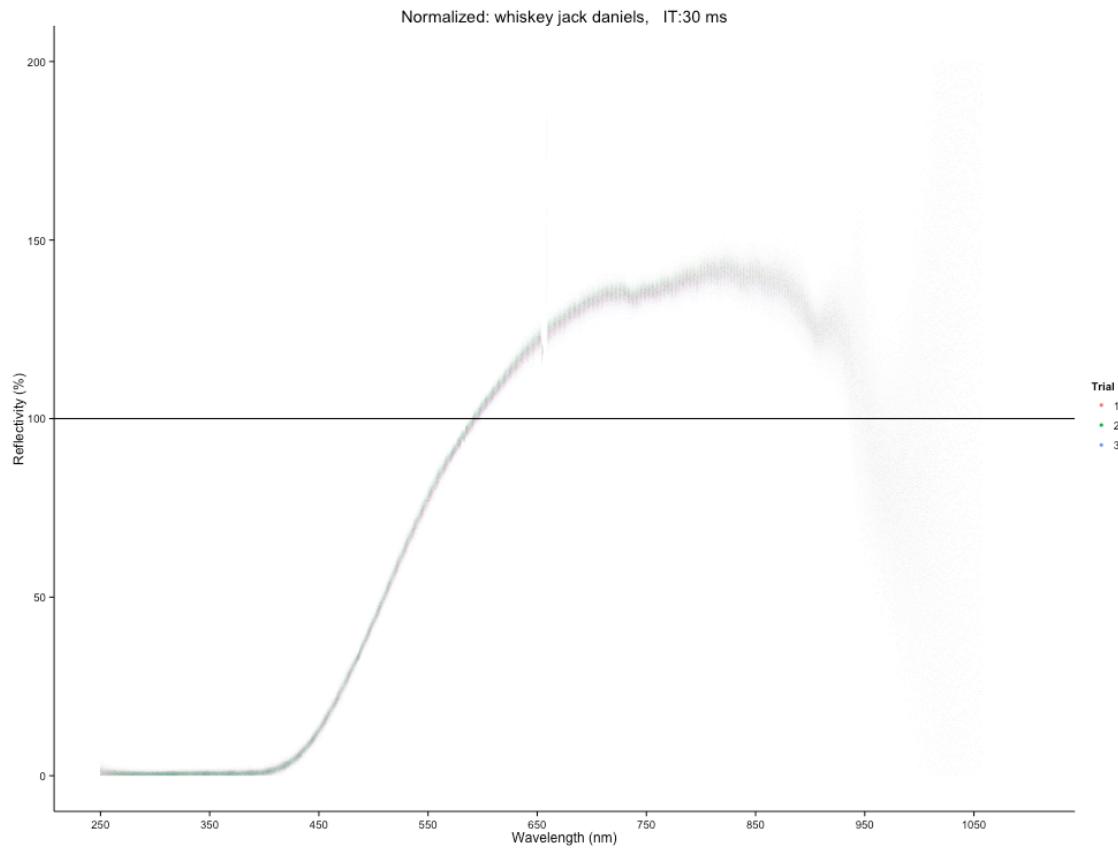
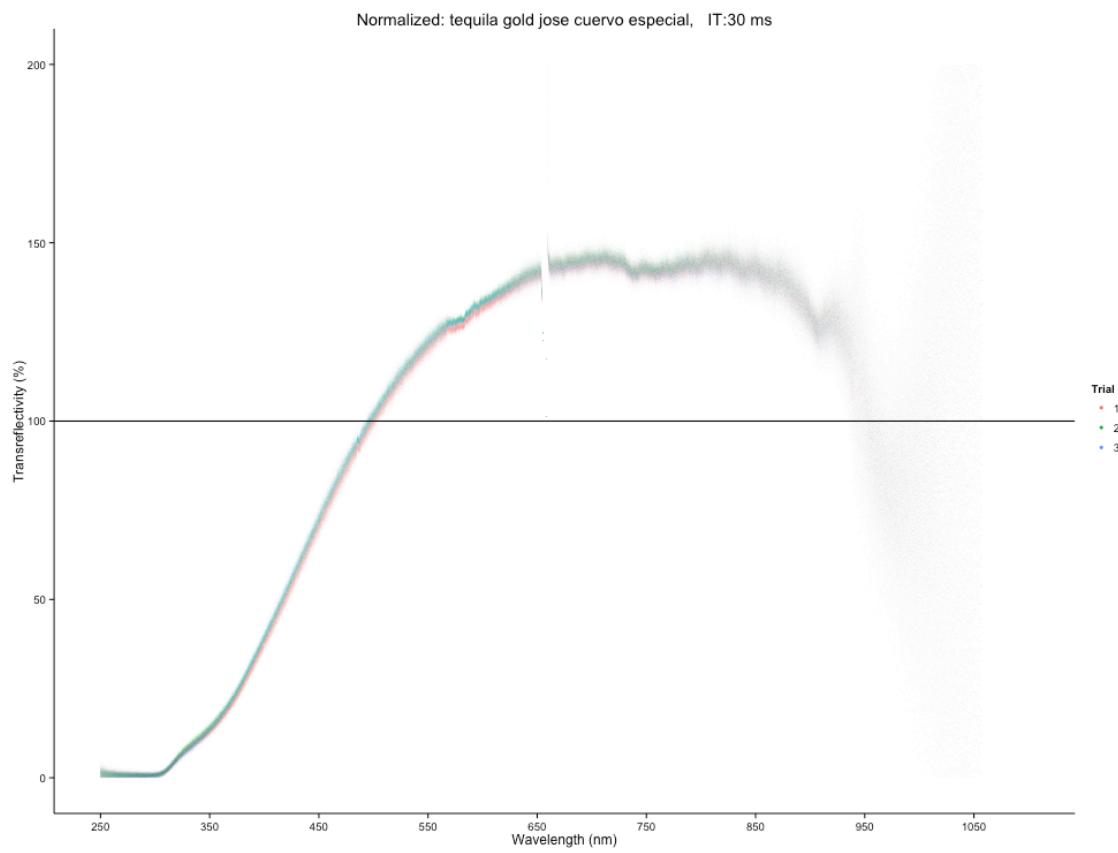
Appendix B-Transreflectance

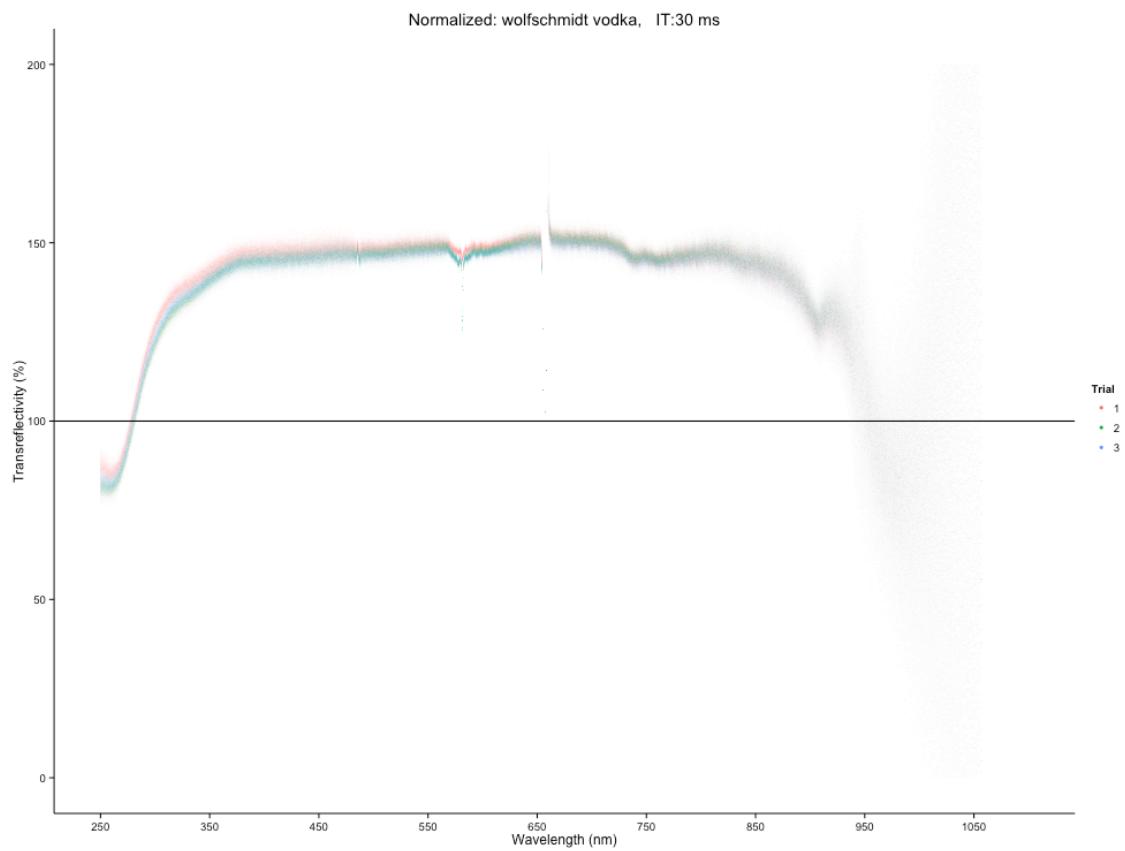
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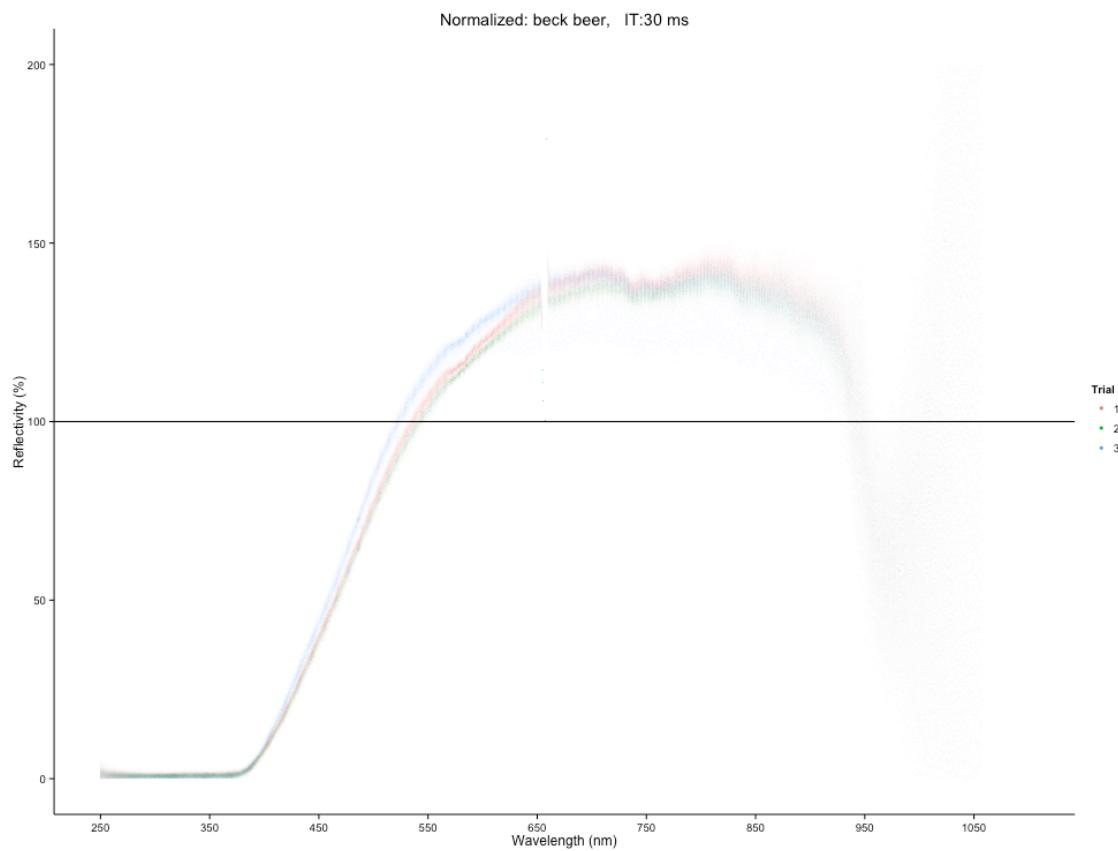


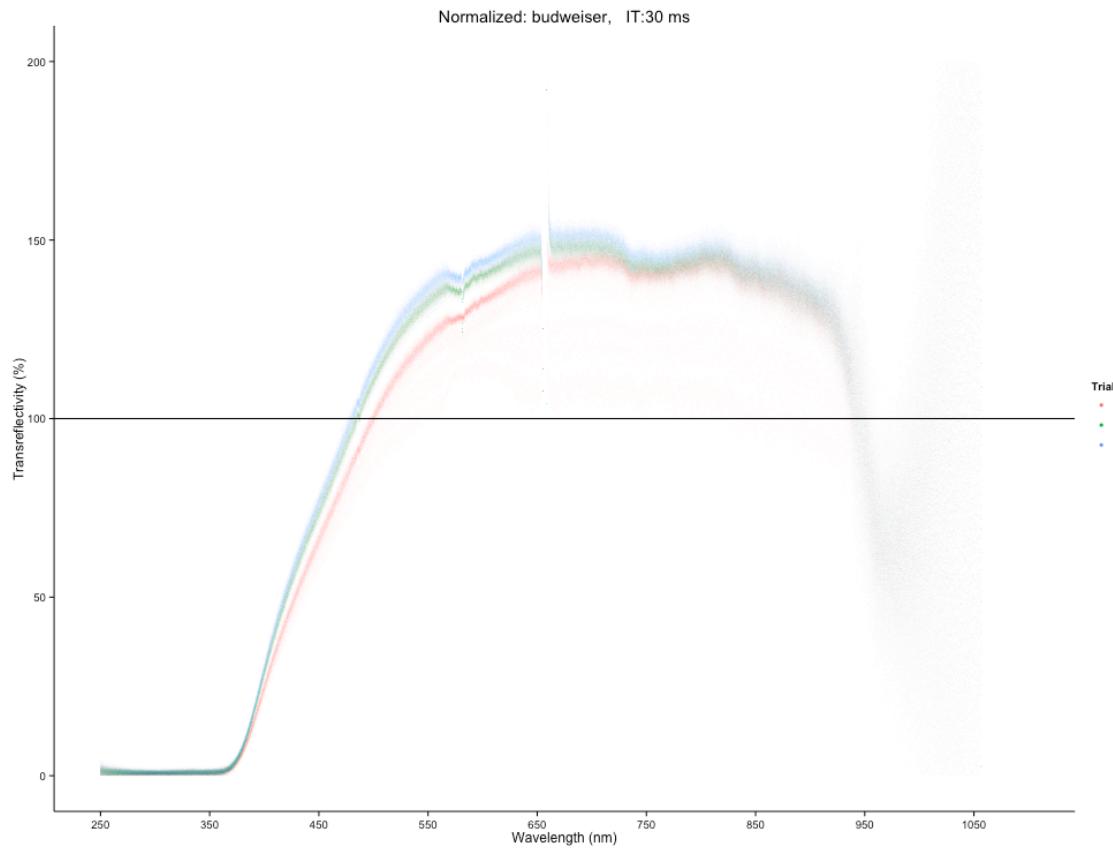
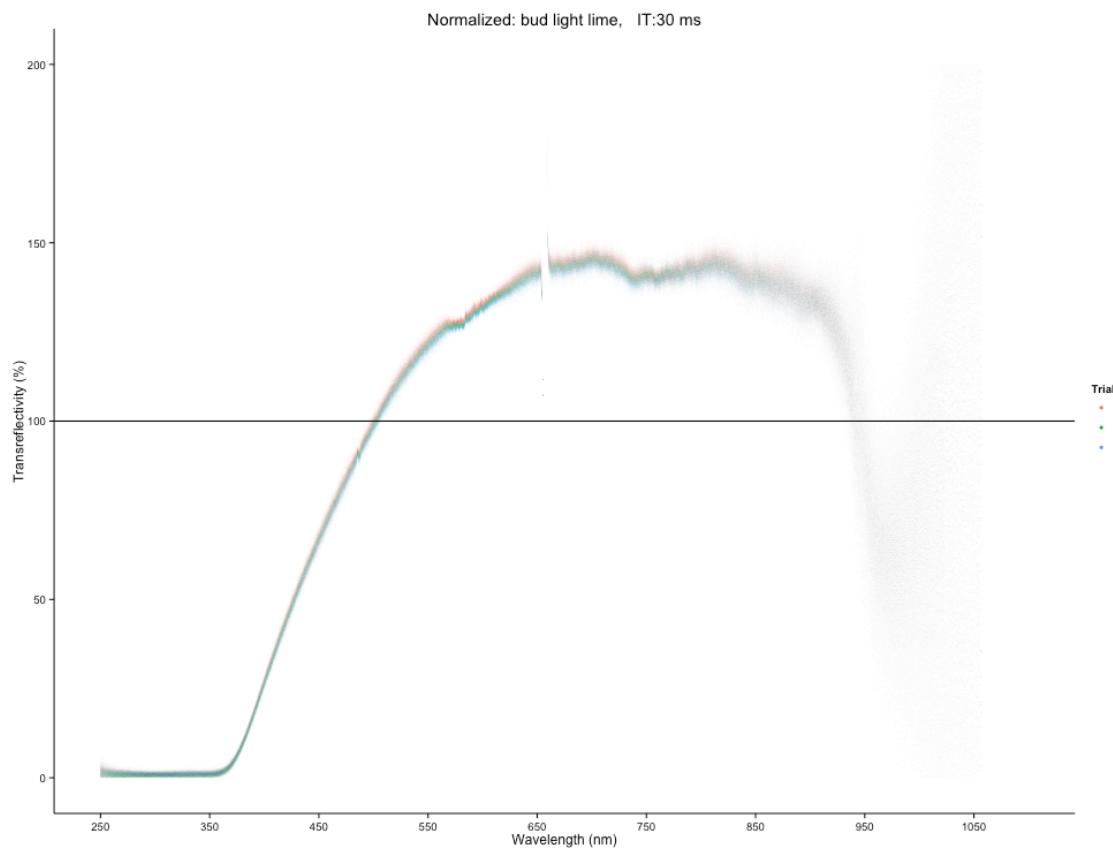


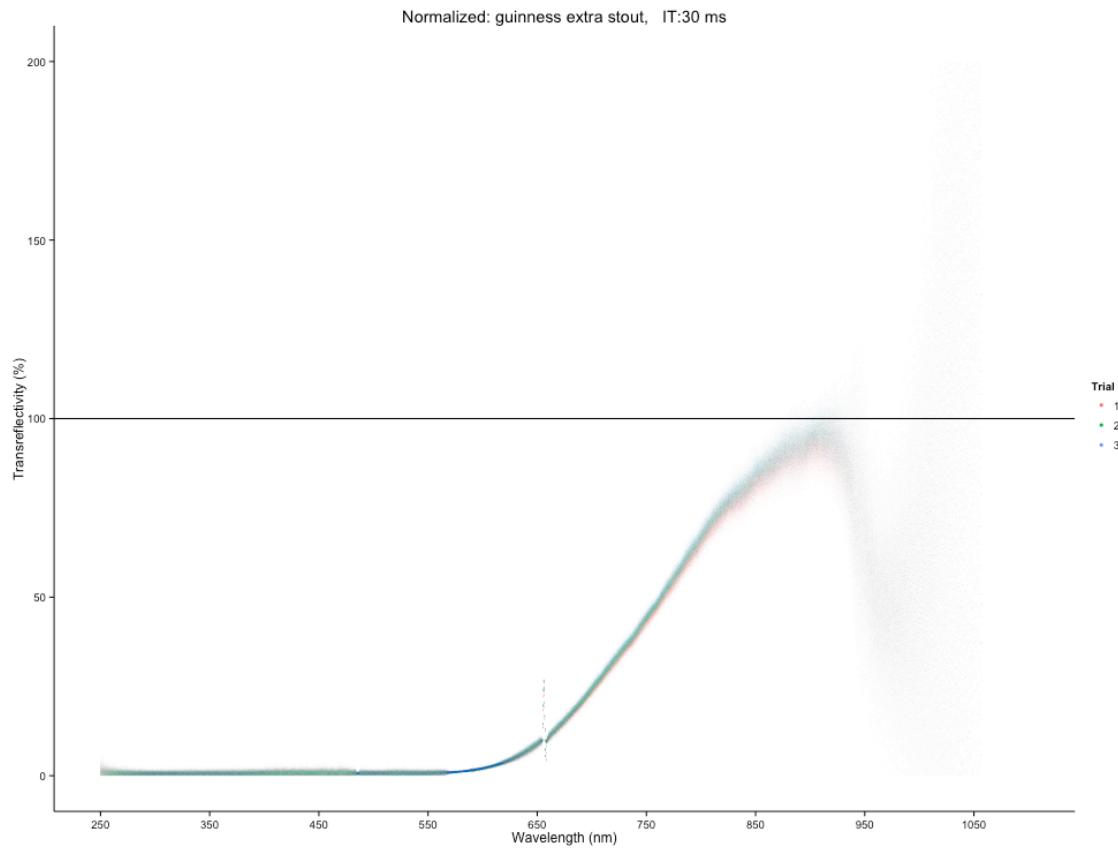
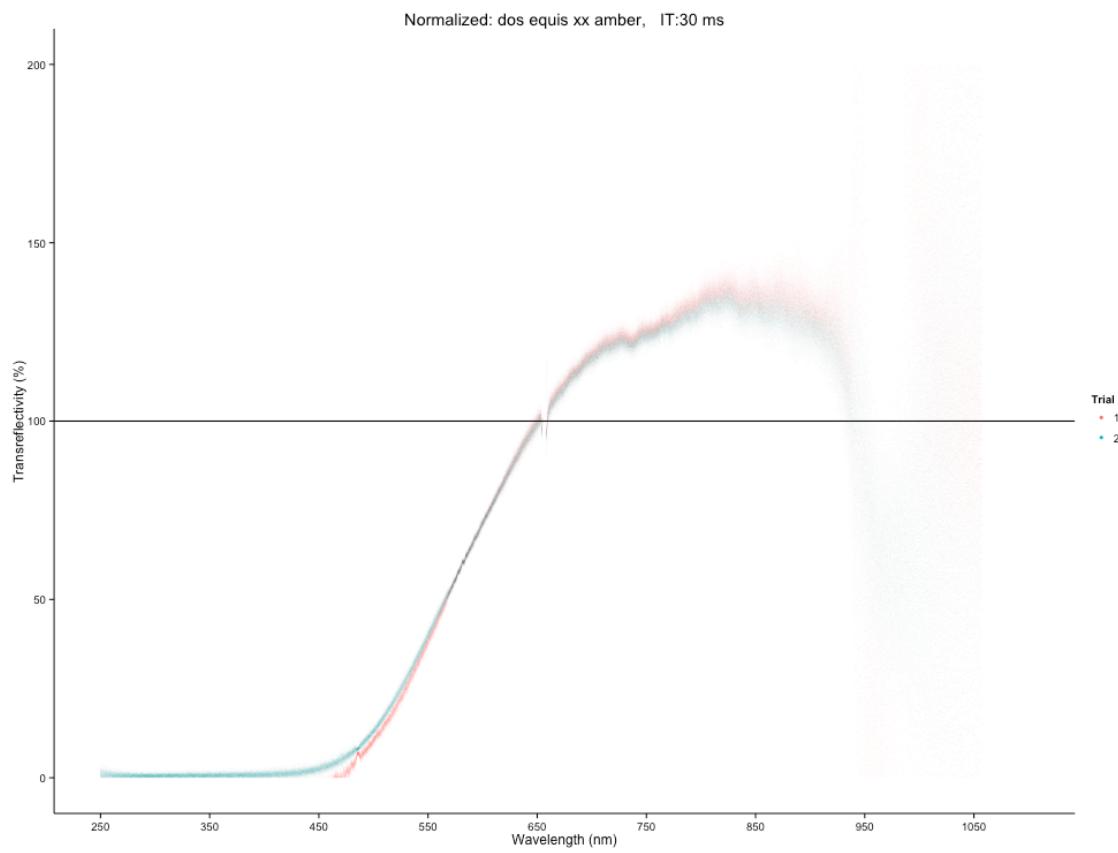


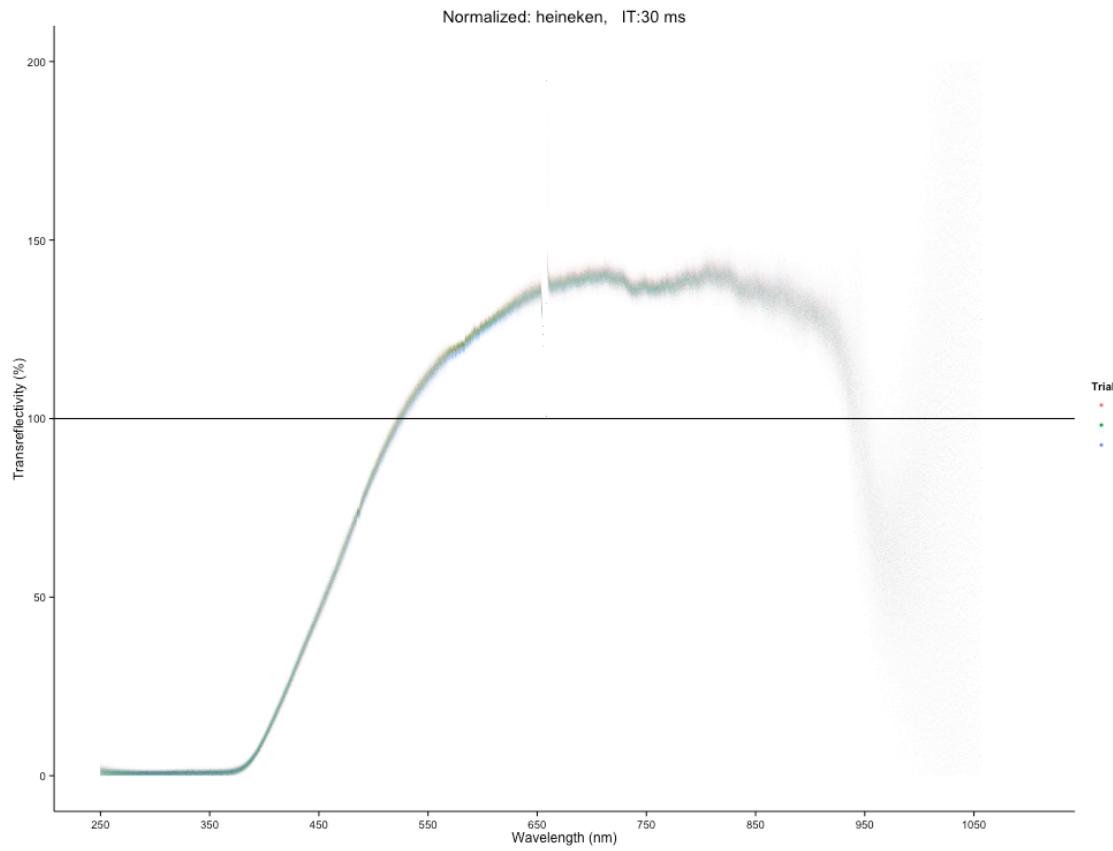
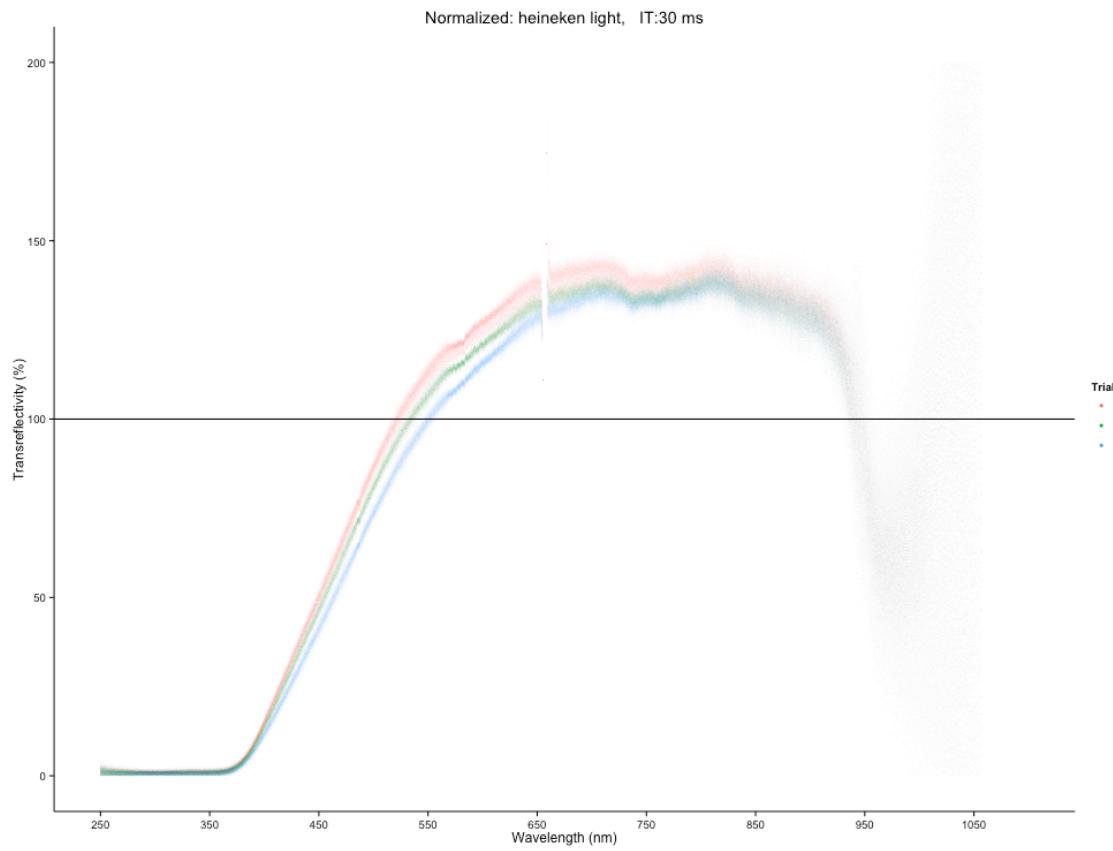


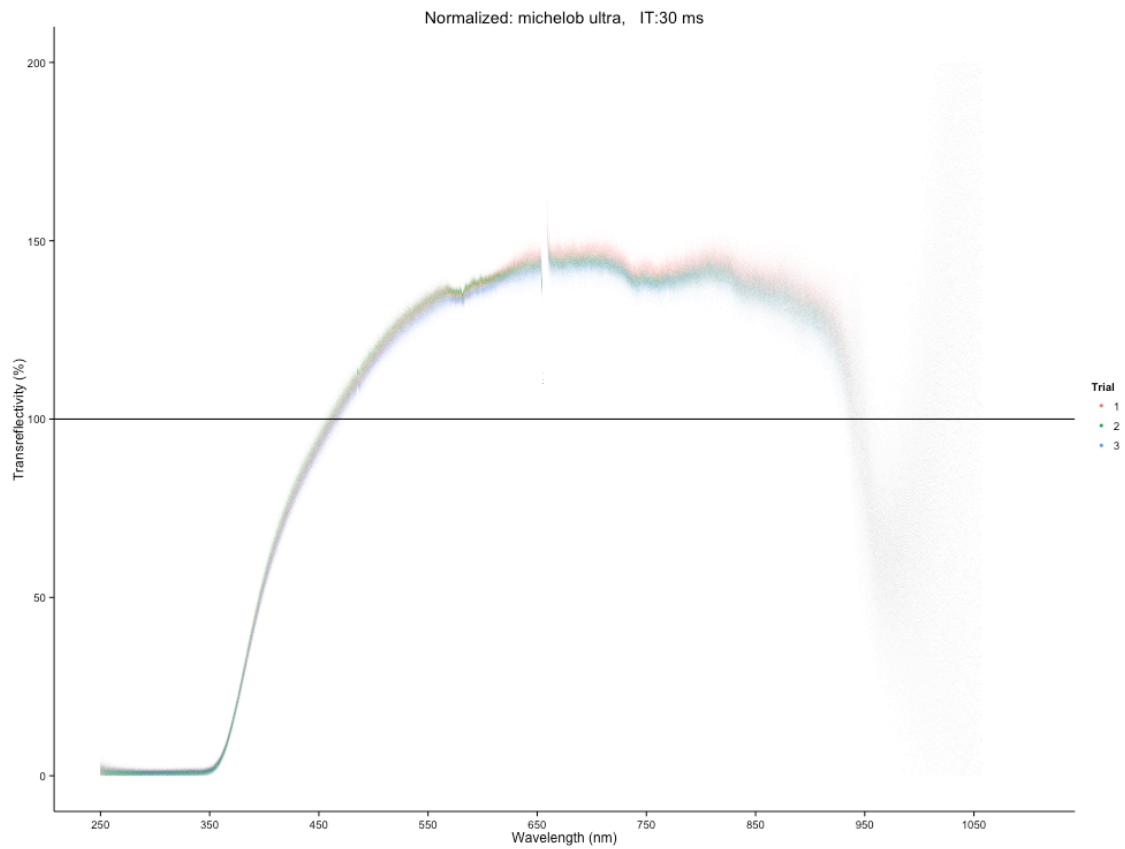
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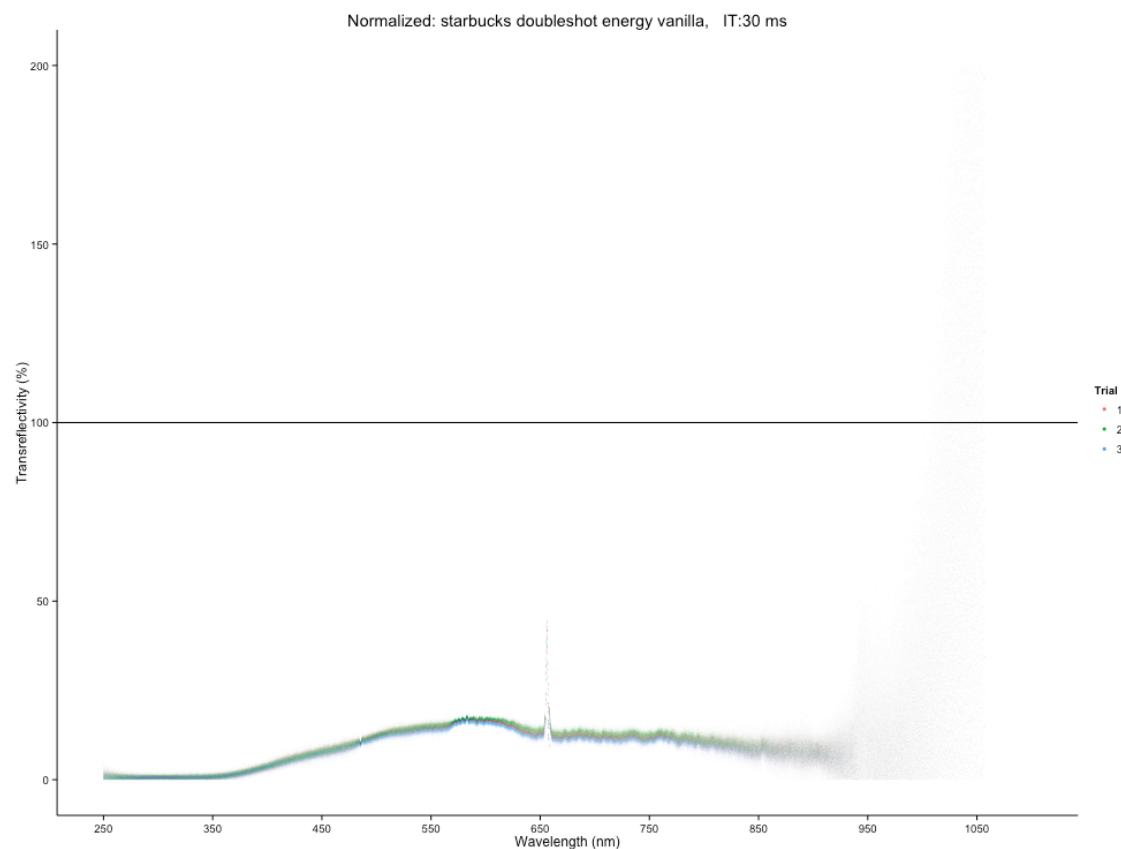
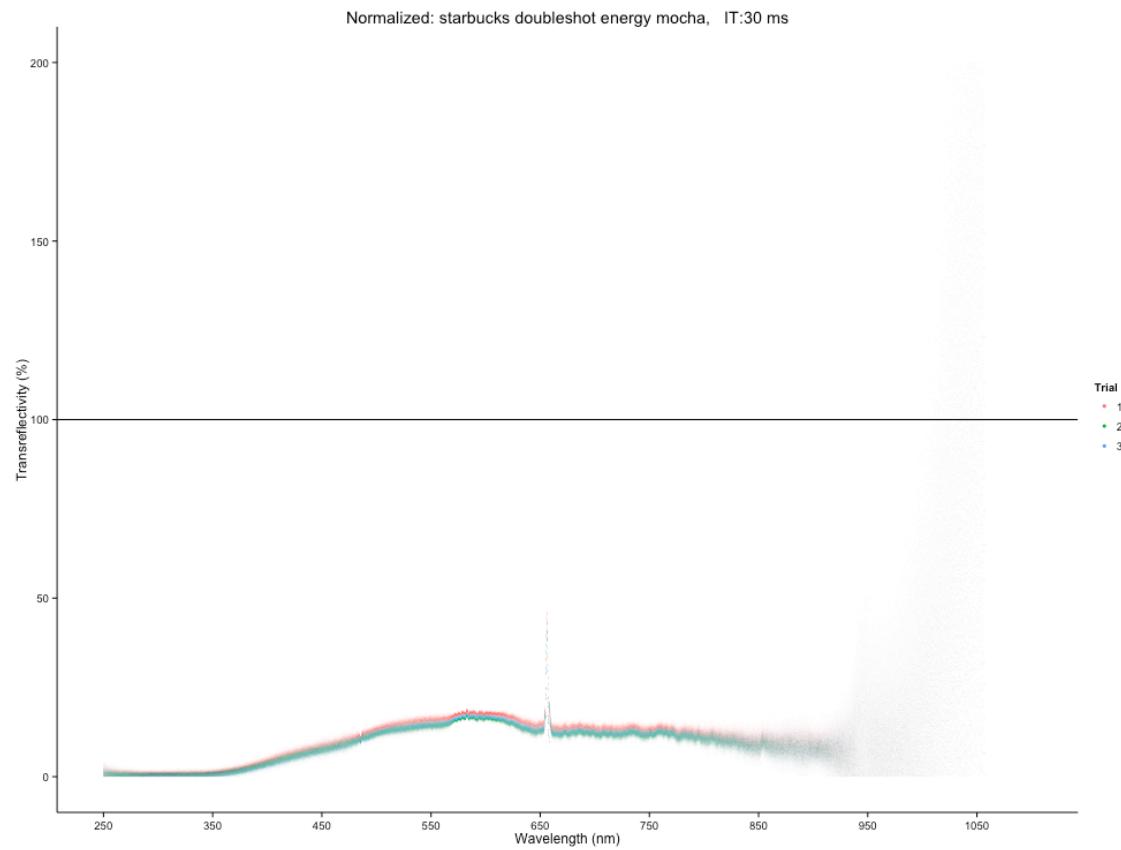


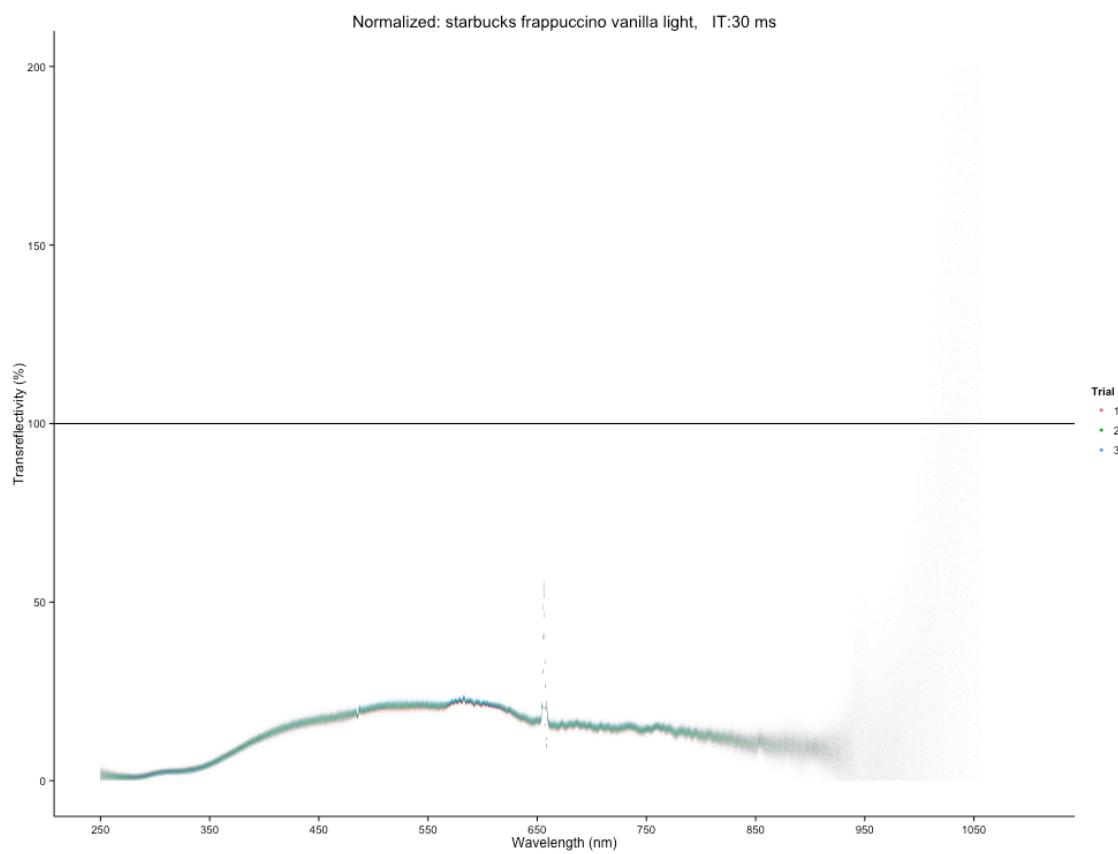
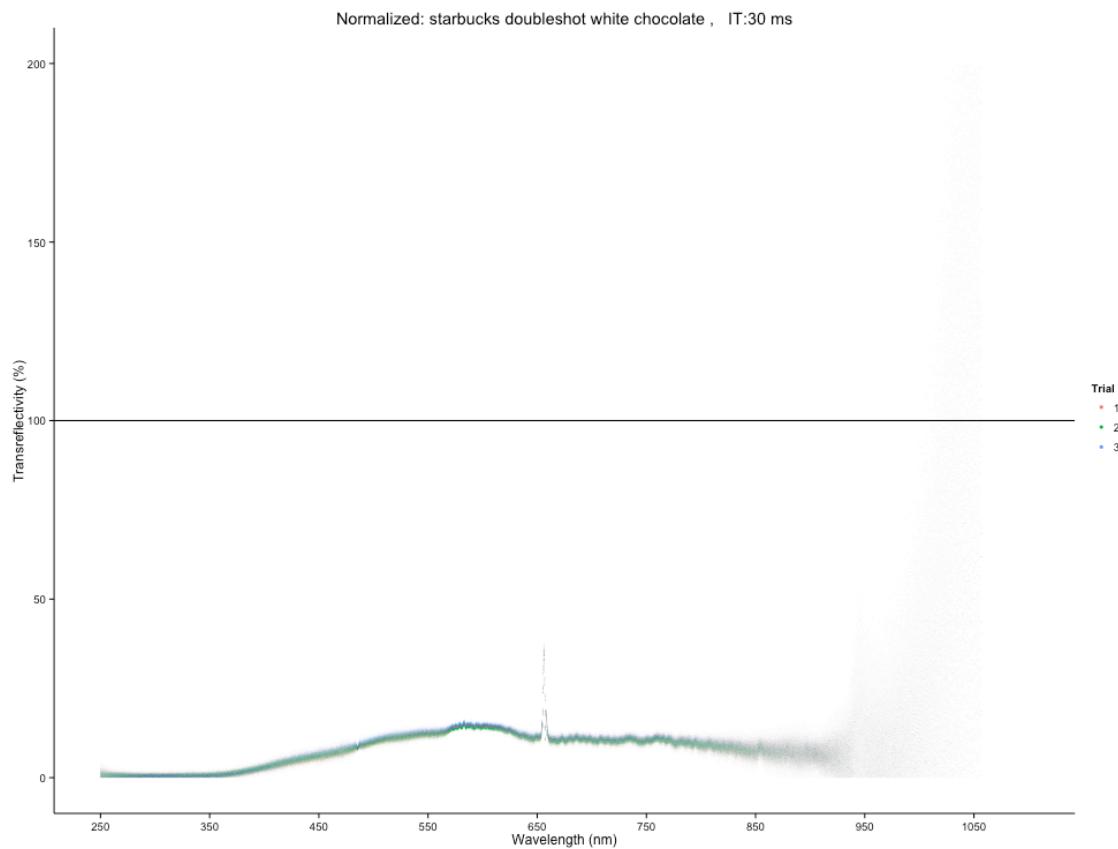


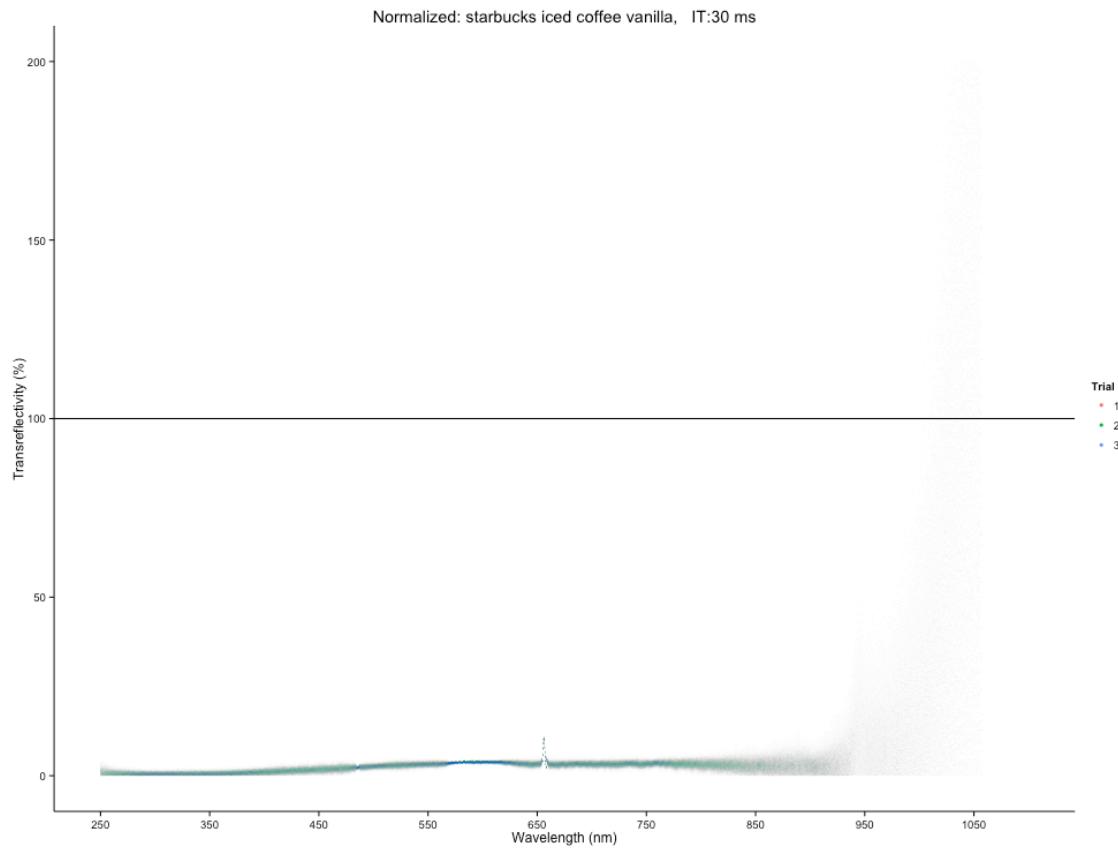
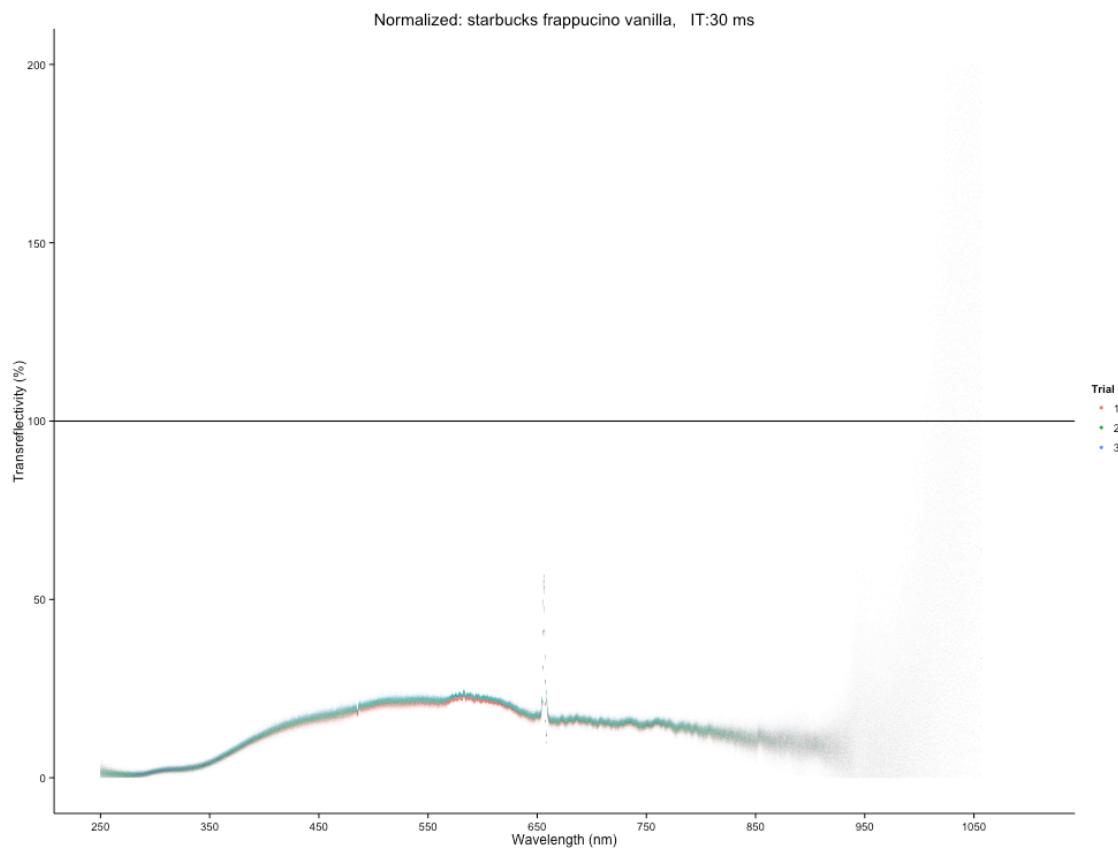


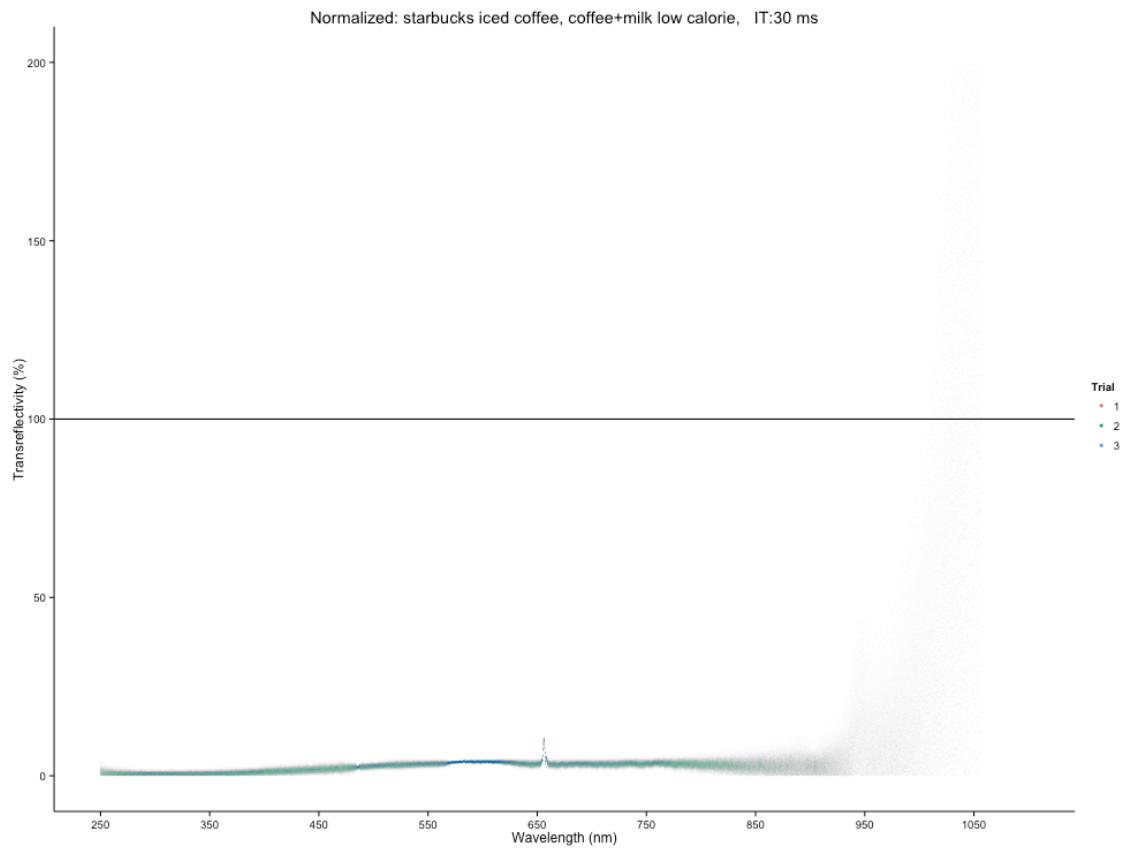


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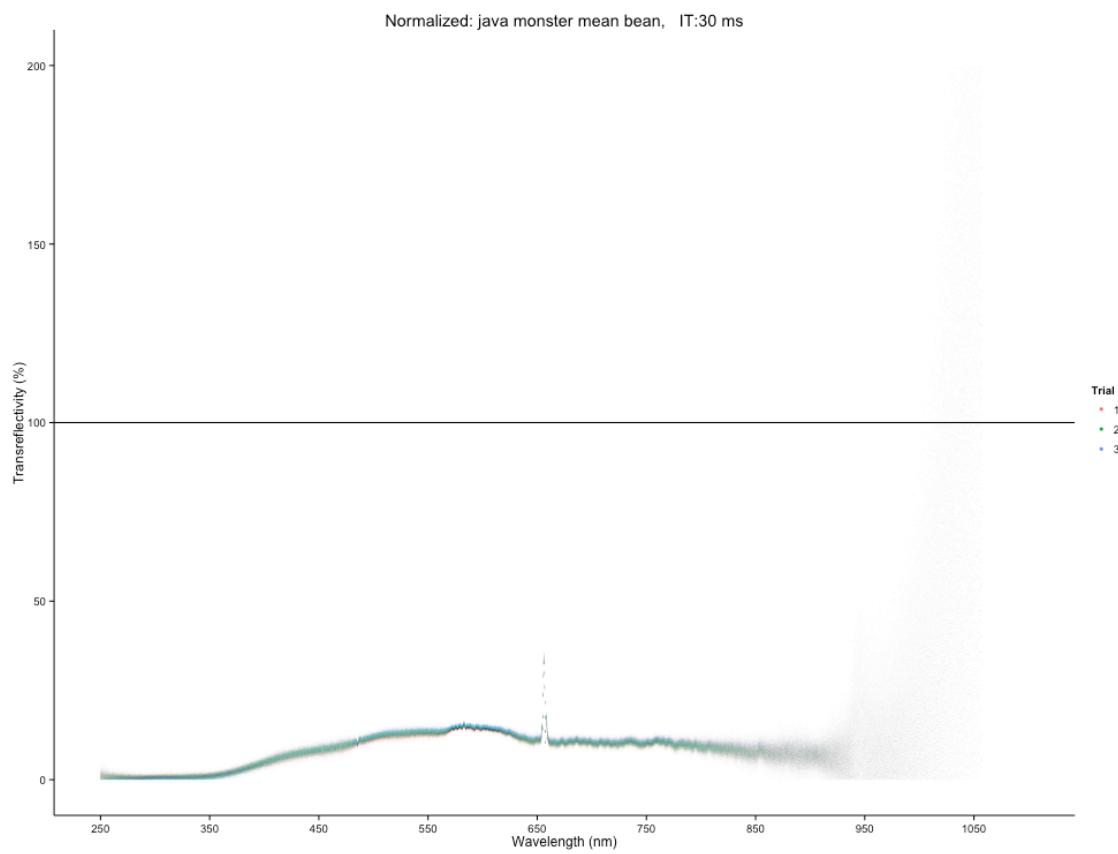


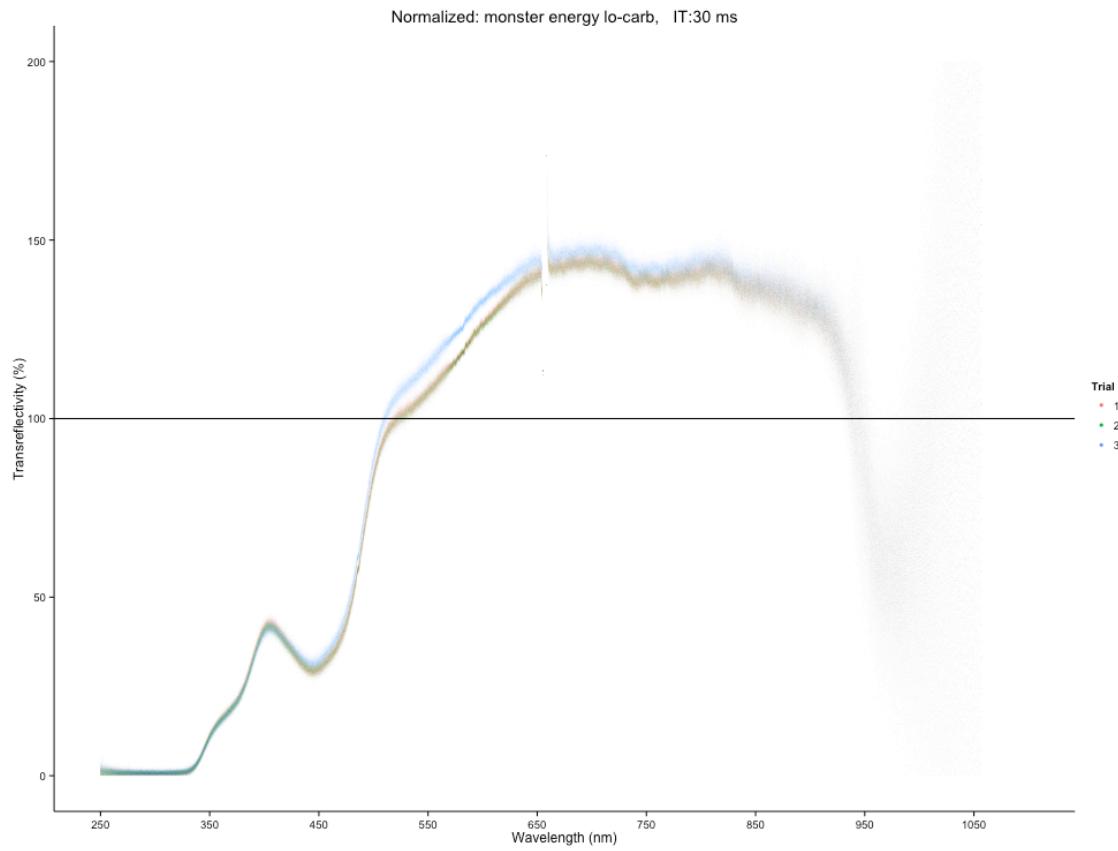
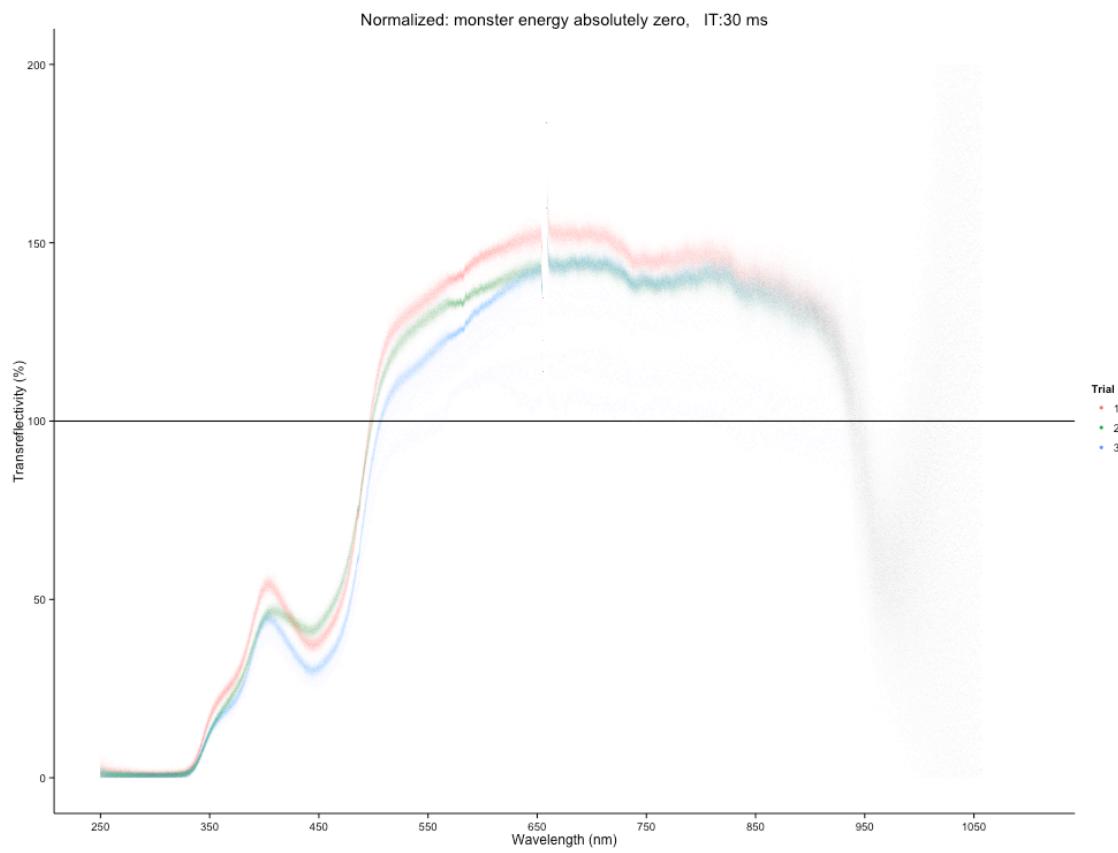


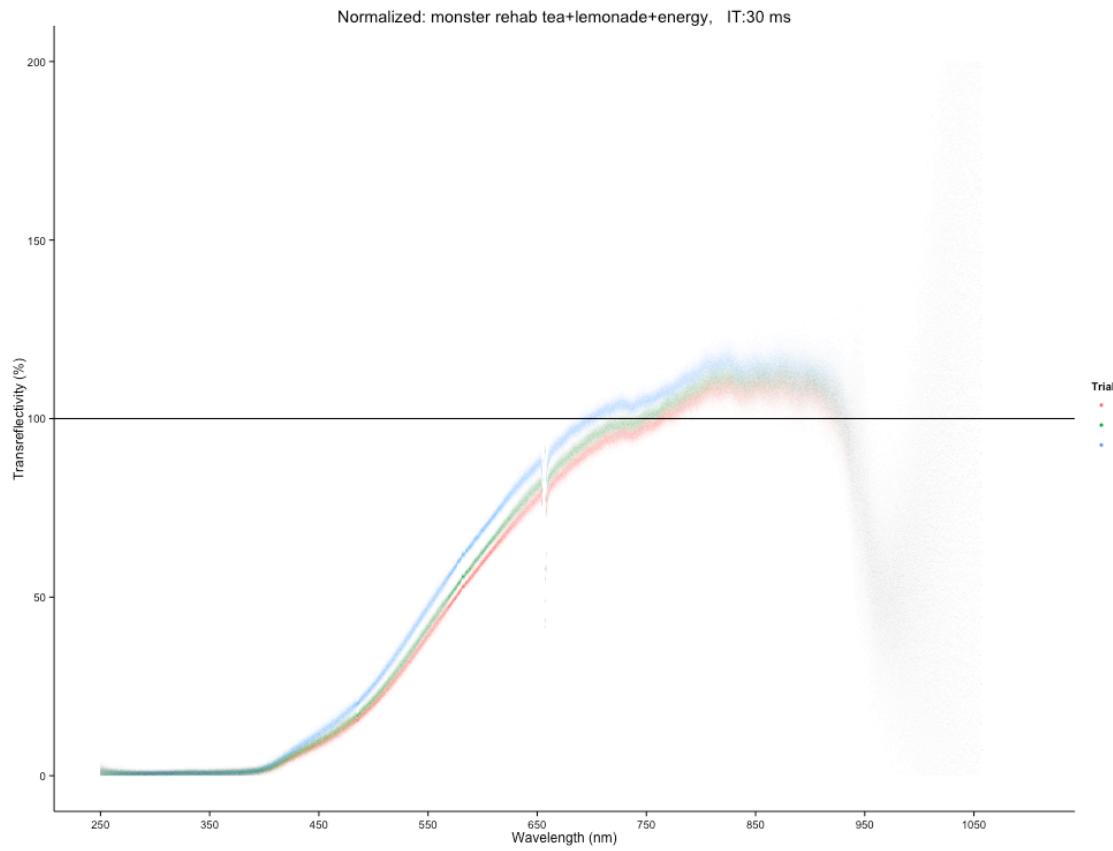
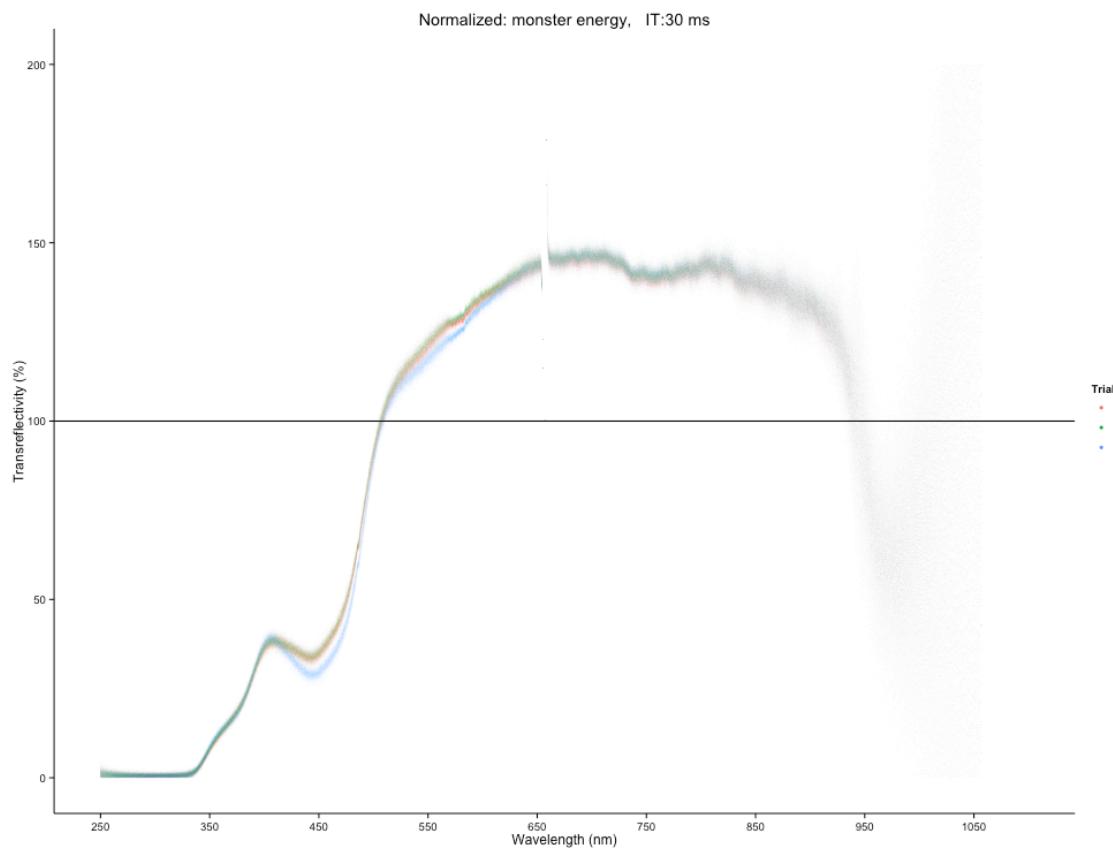


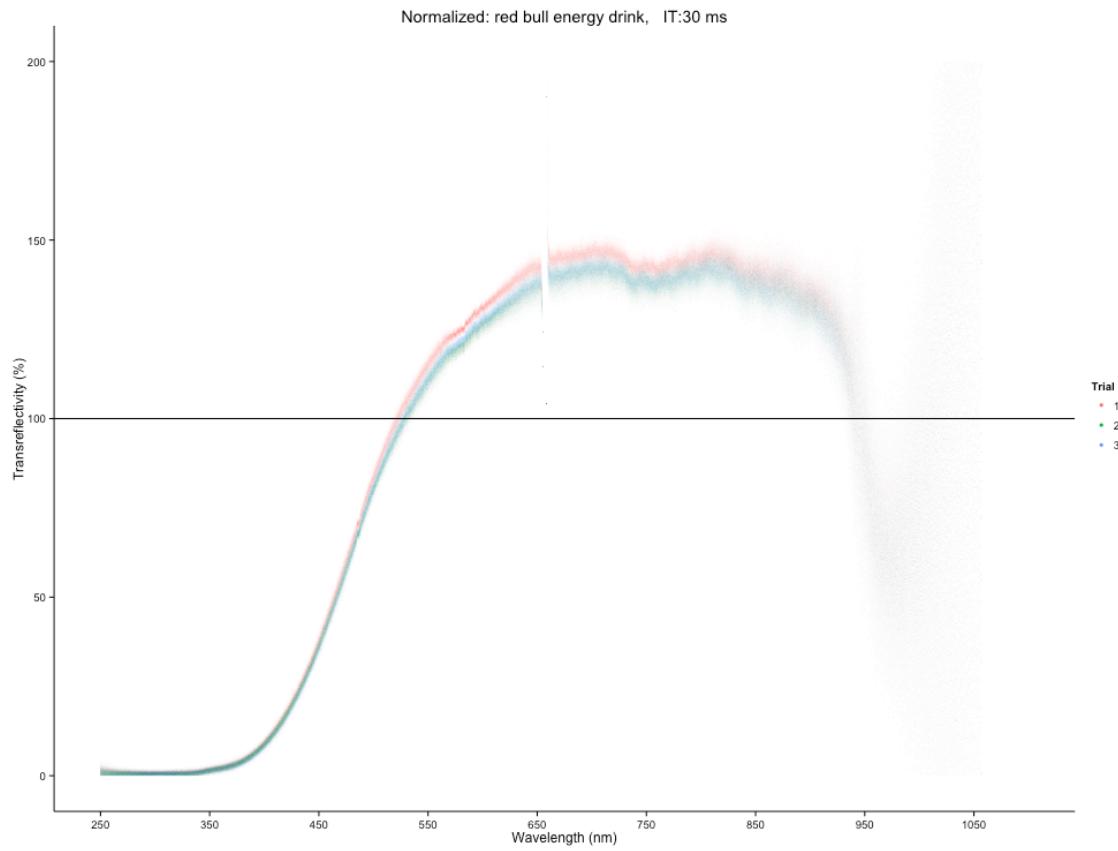
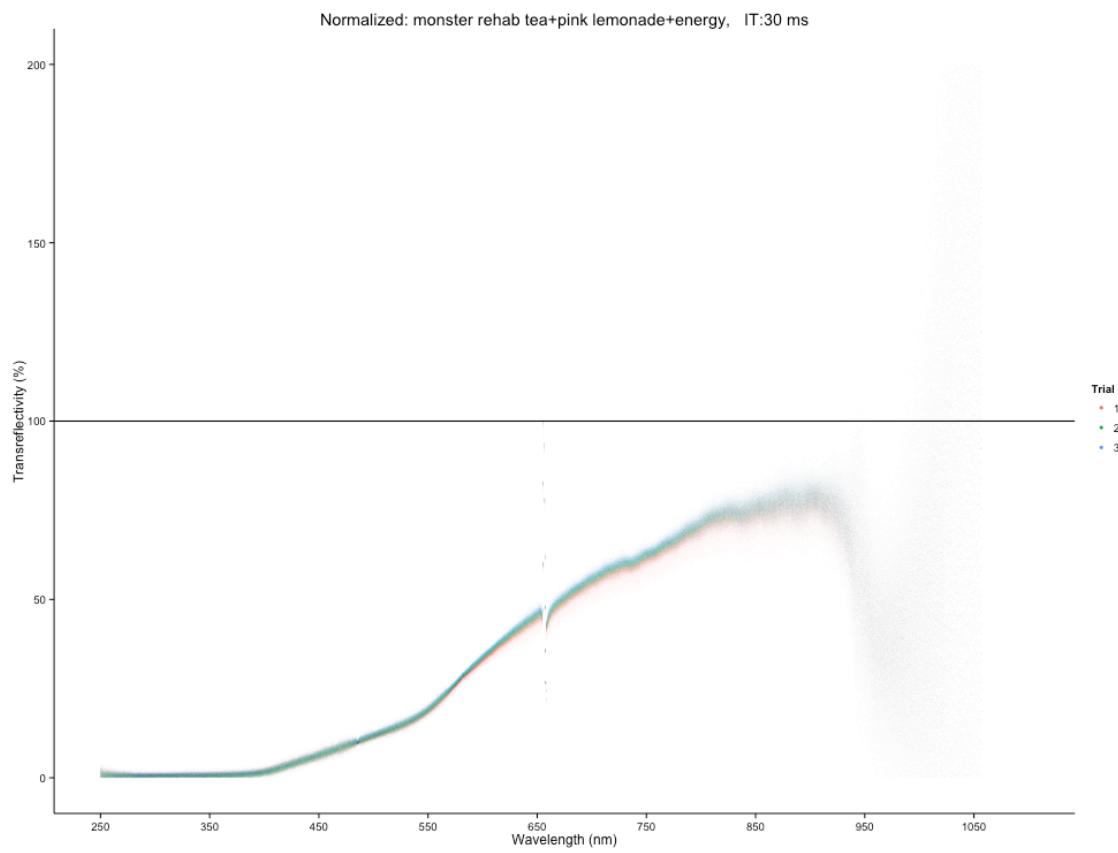


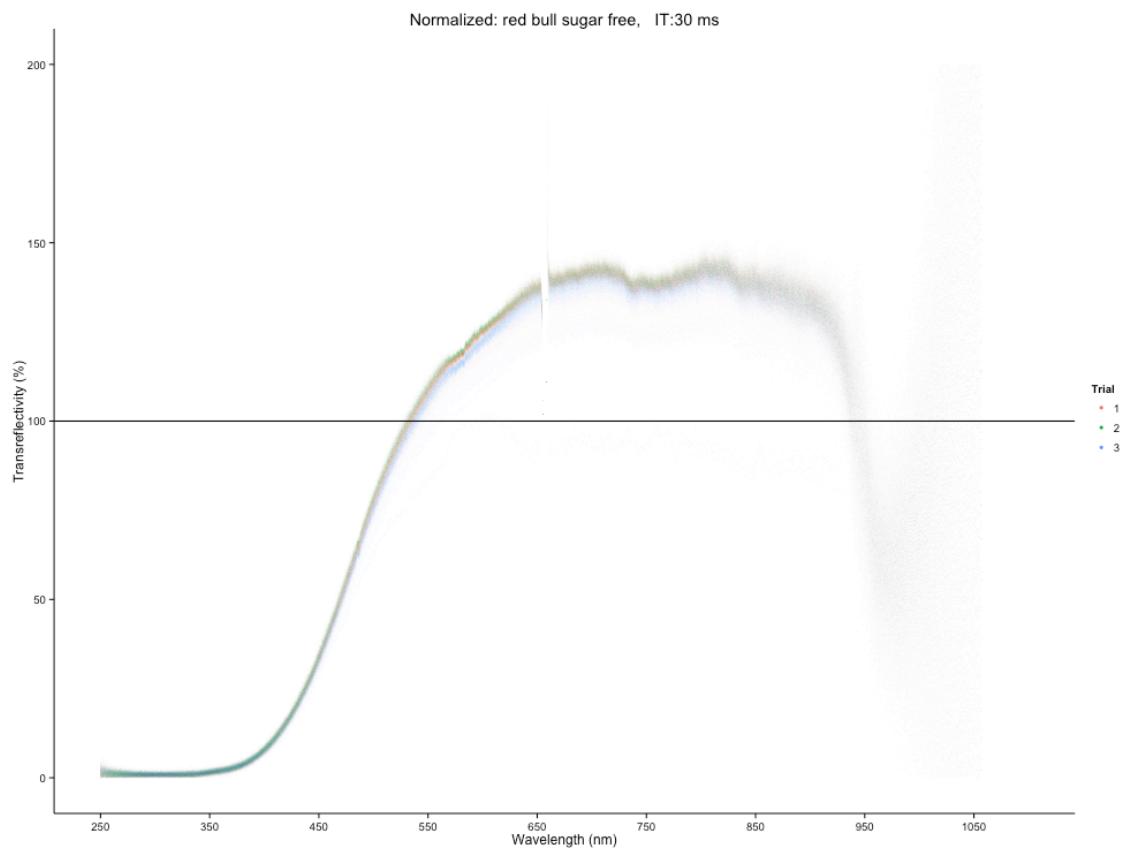
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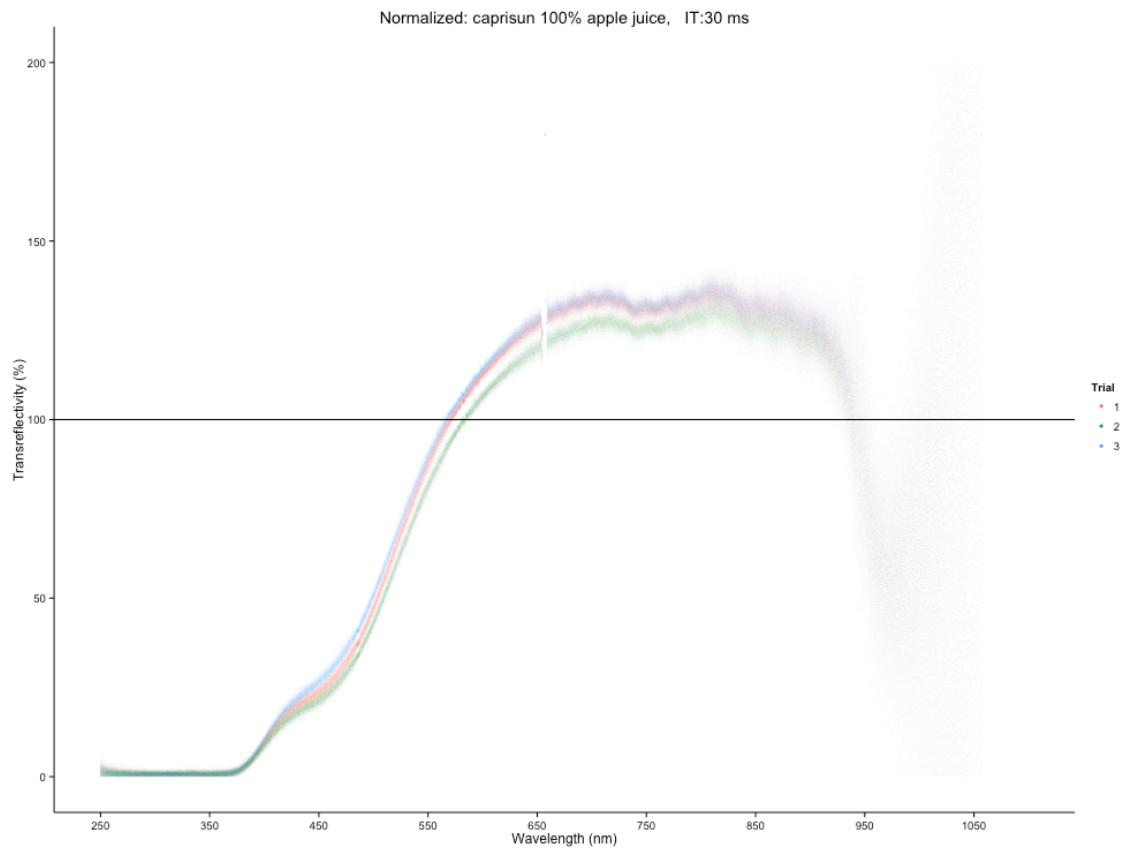


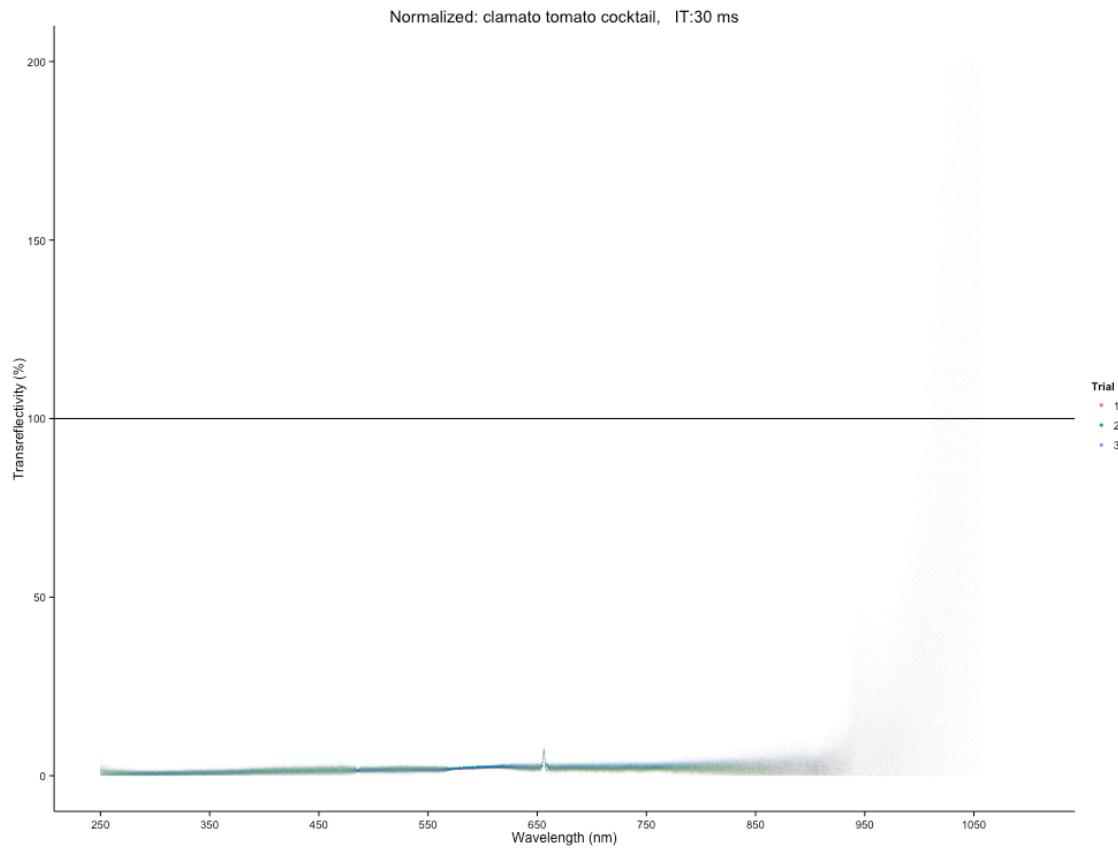
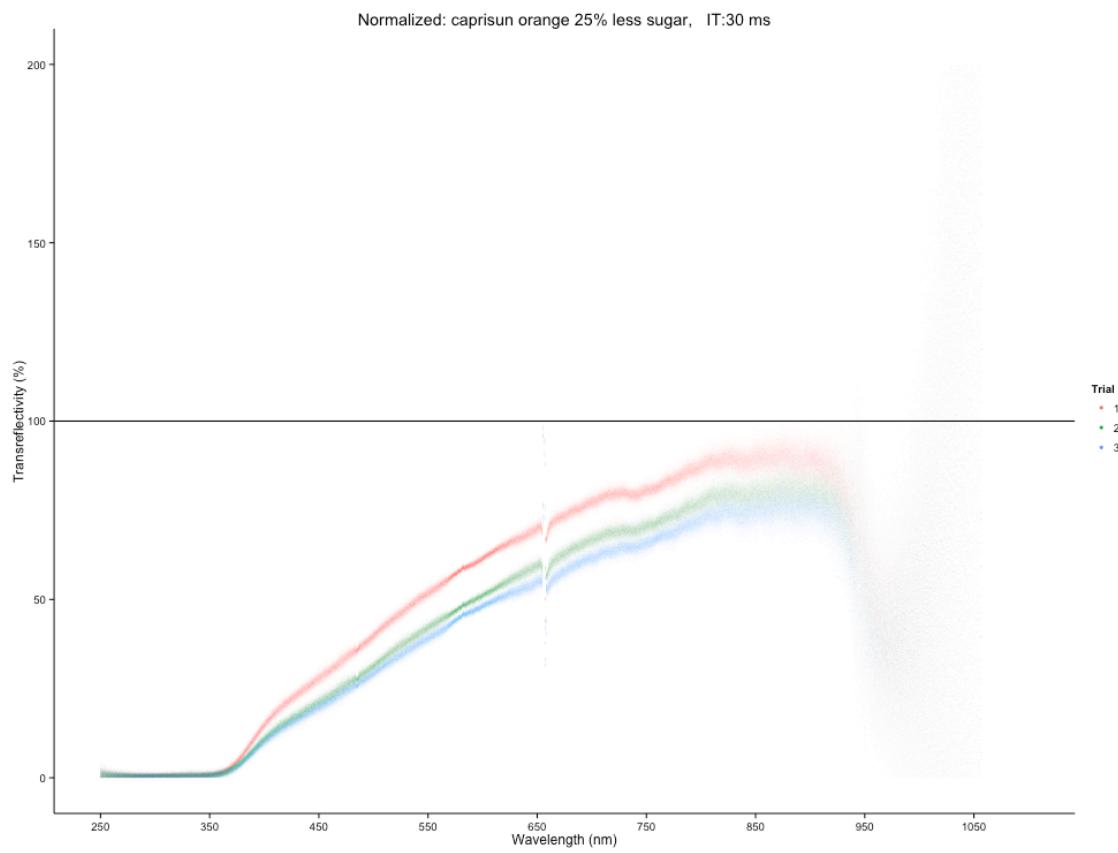


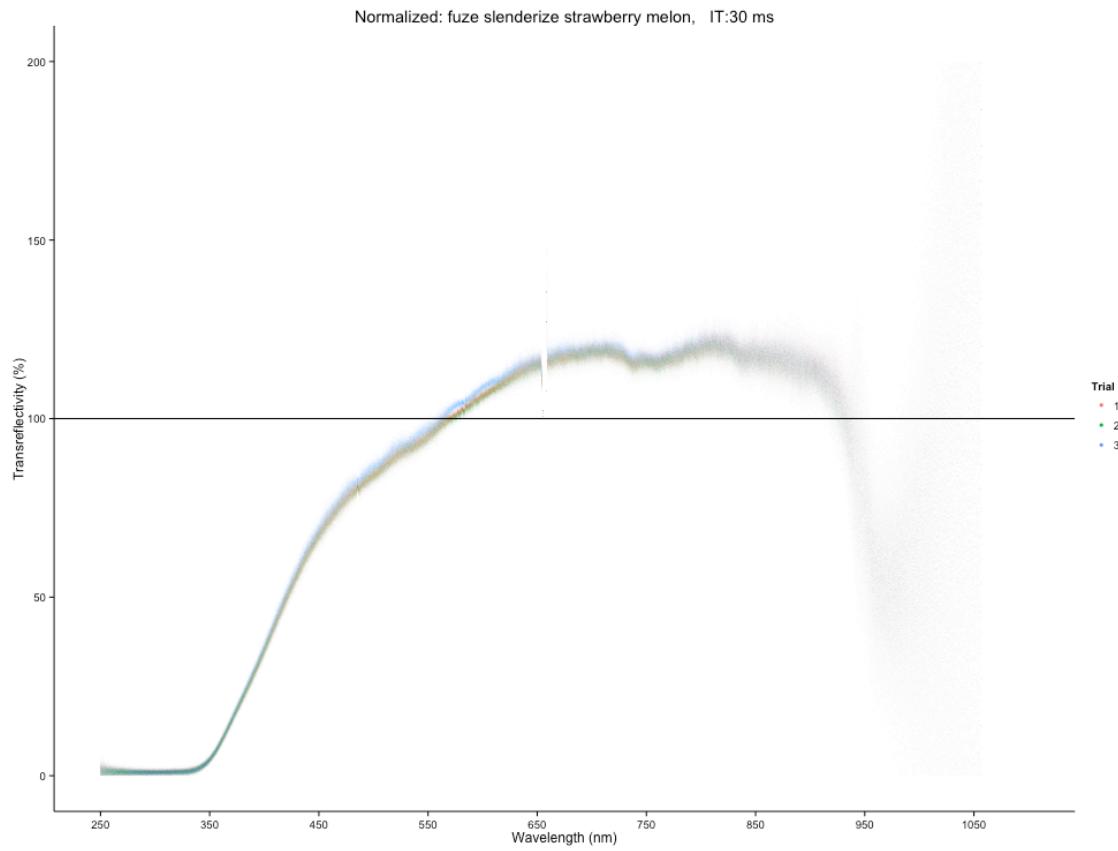
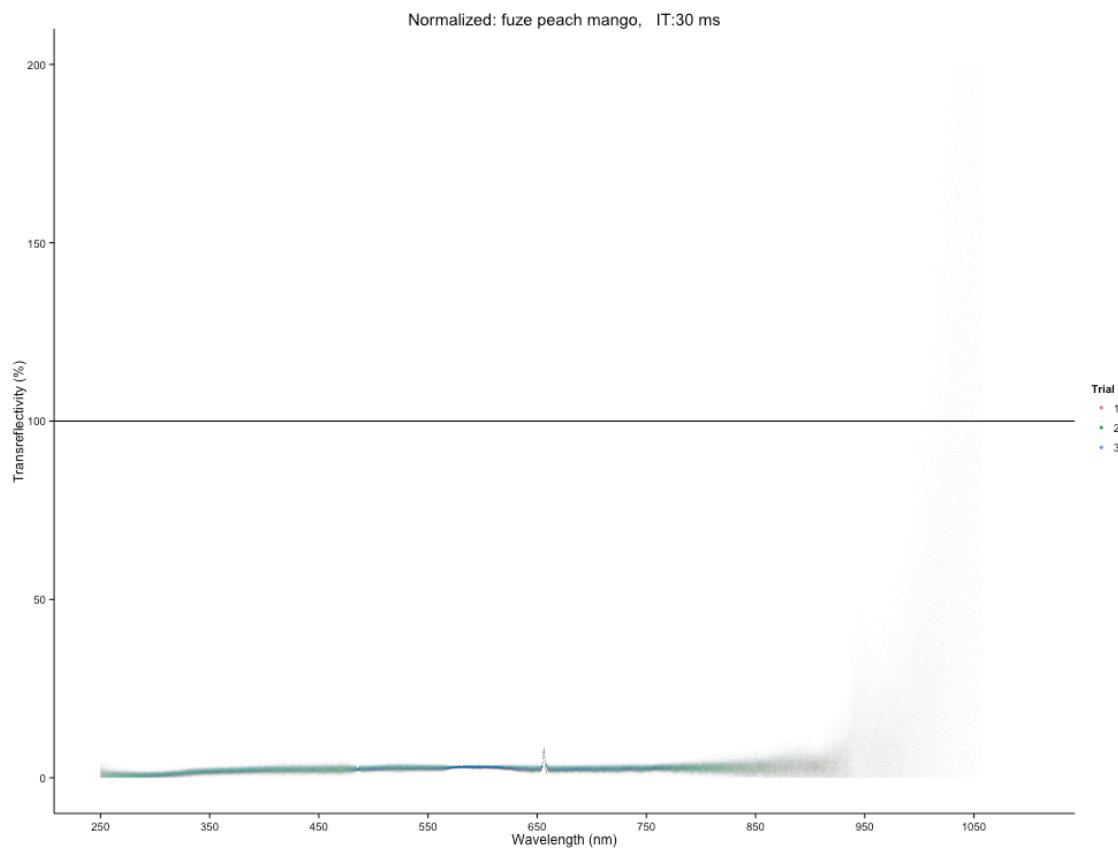


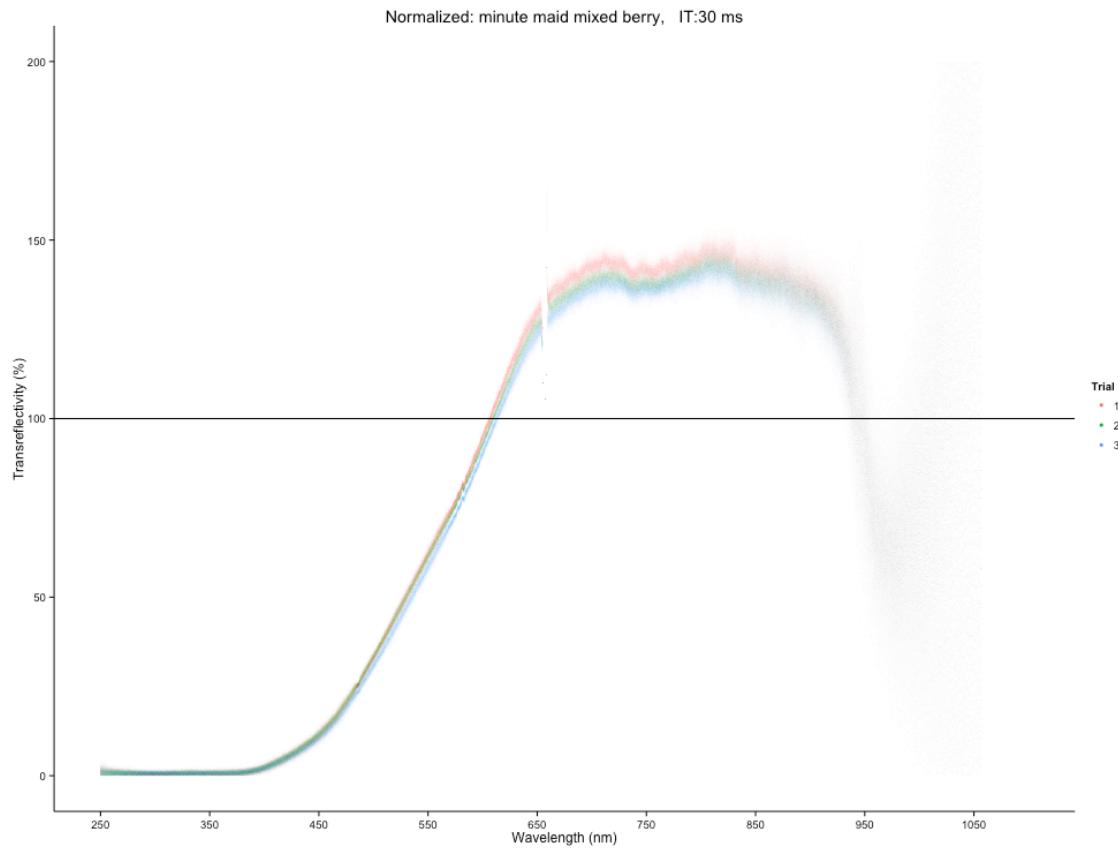
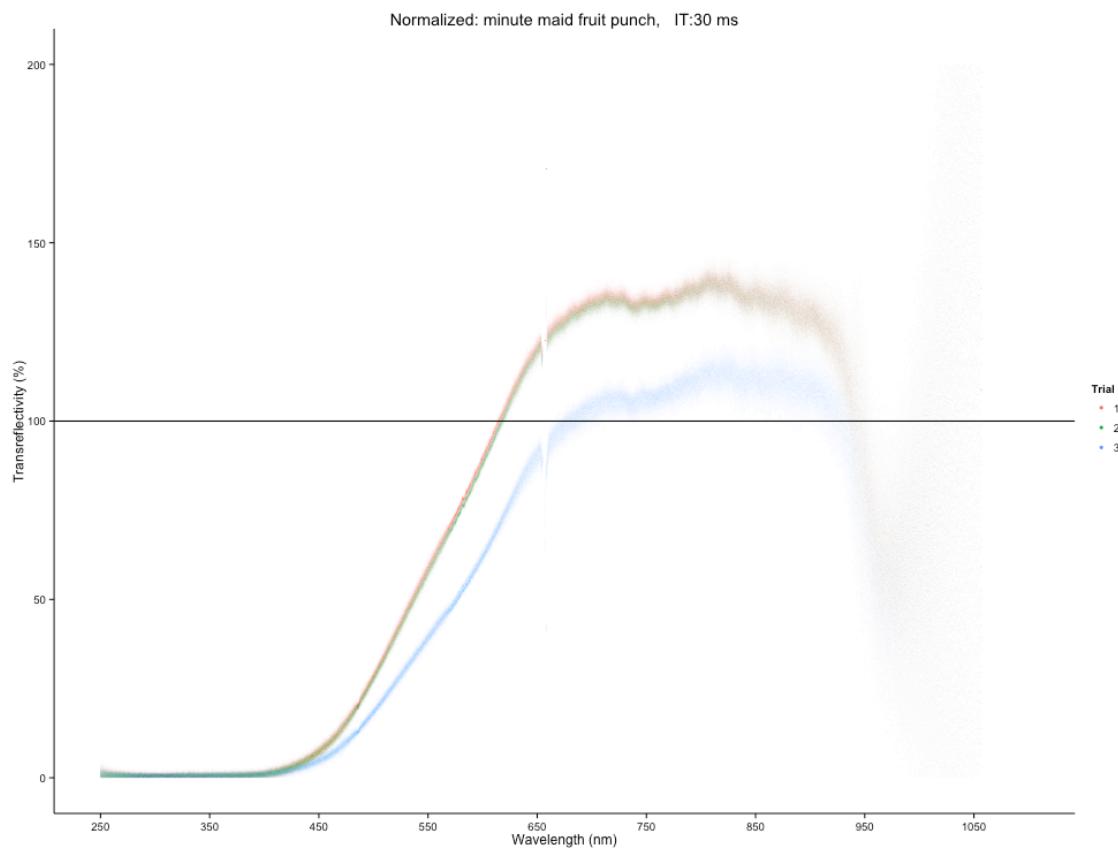


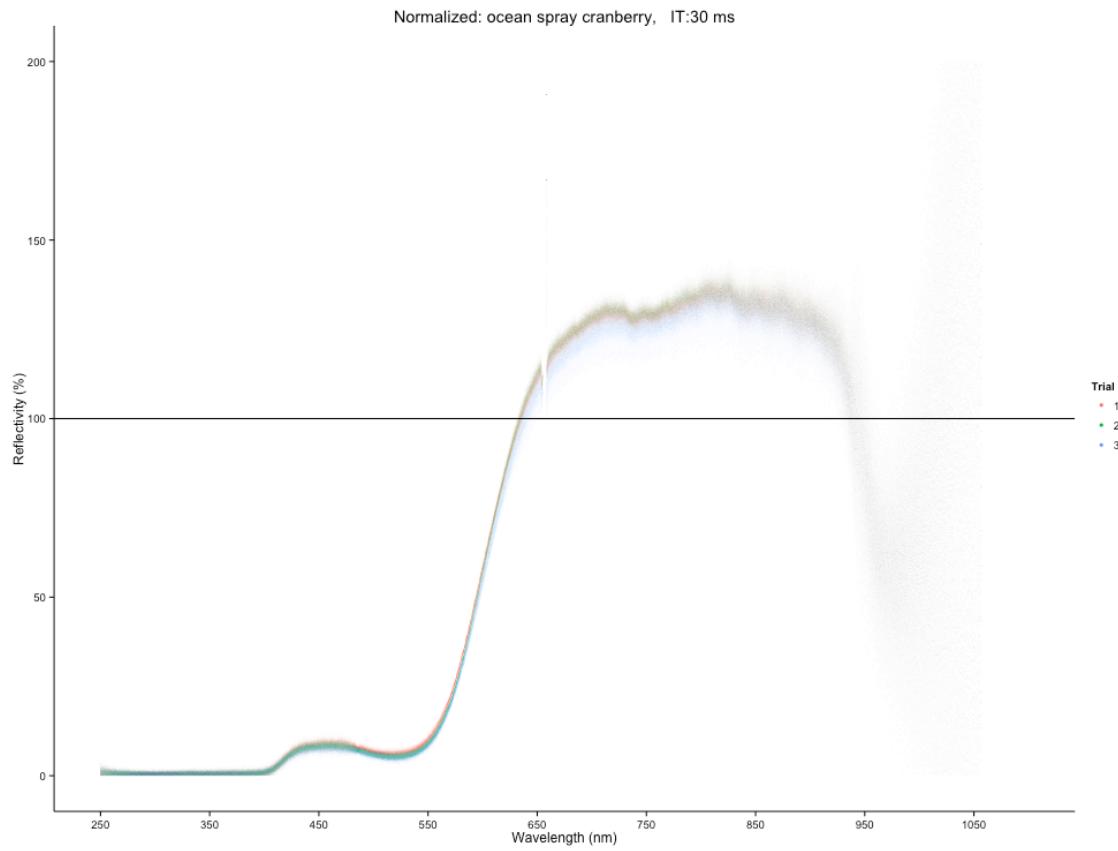
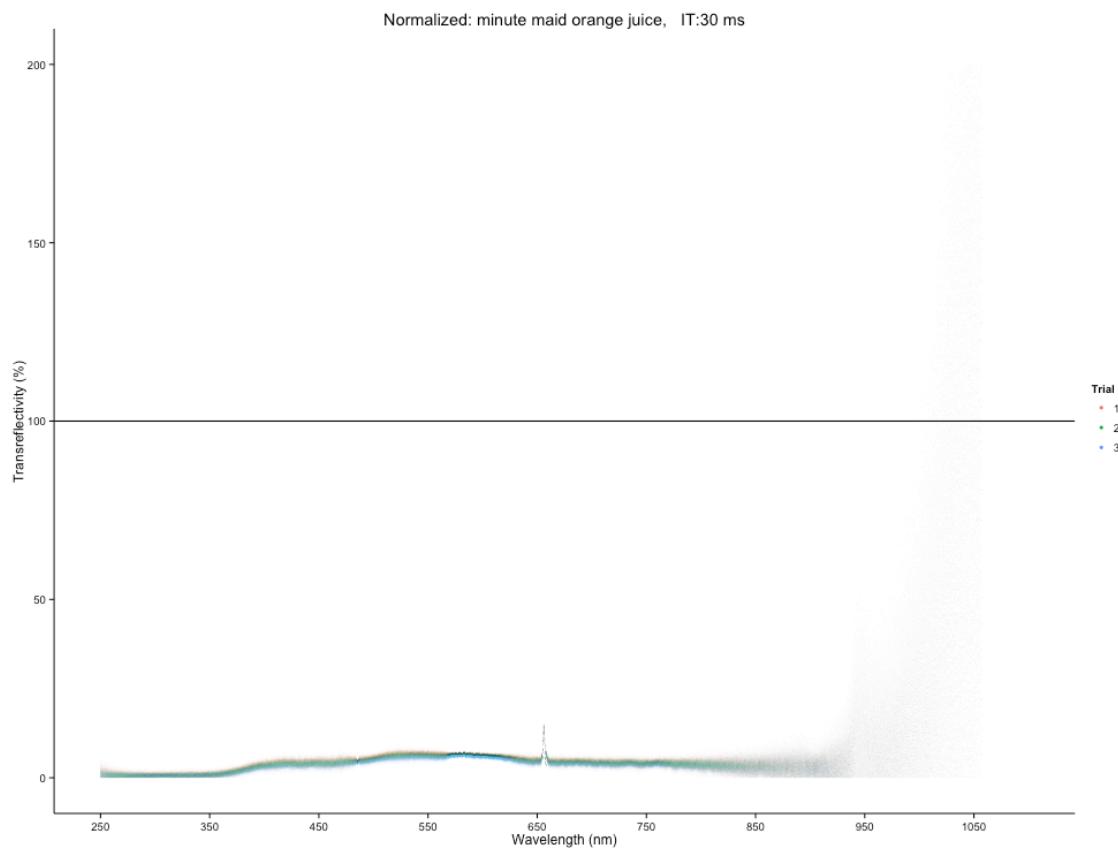
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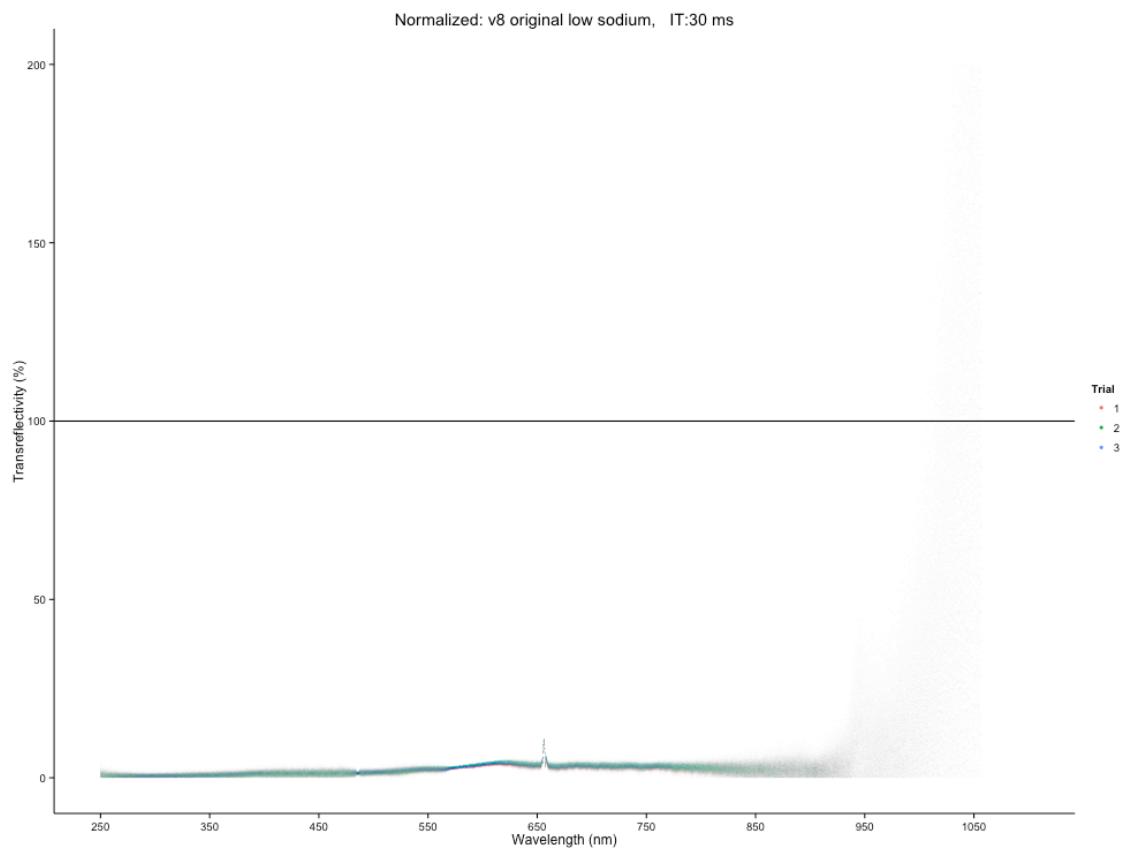




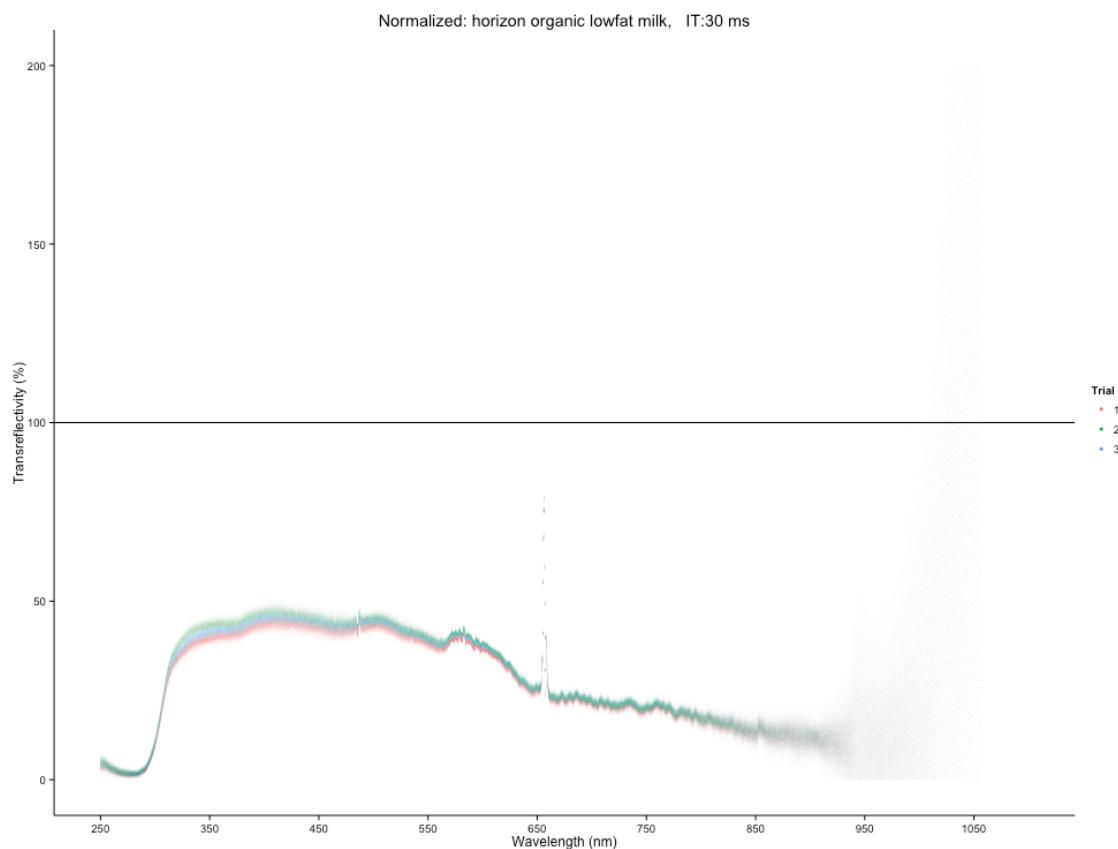
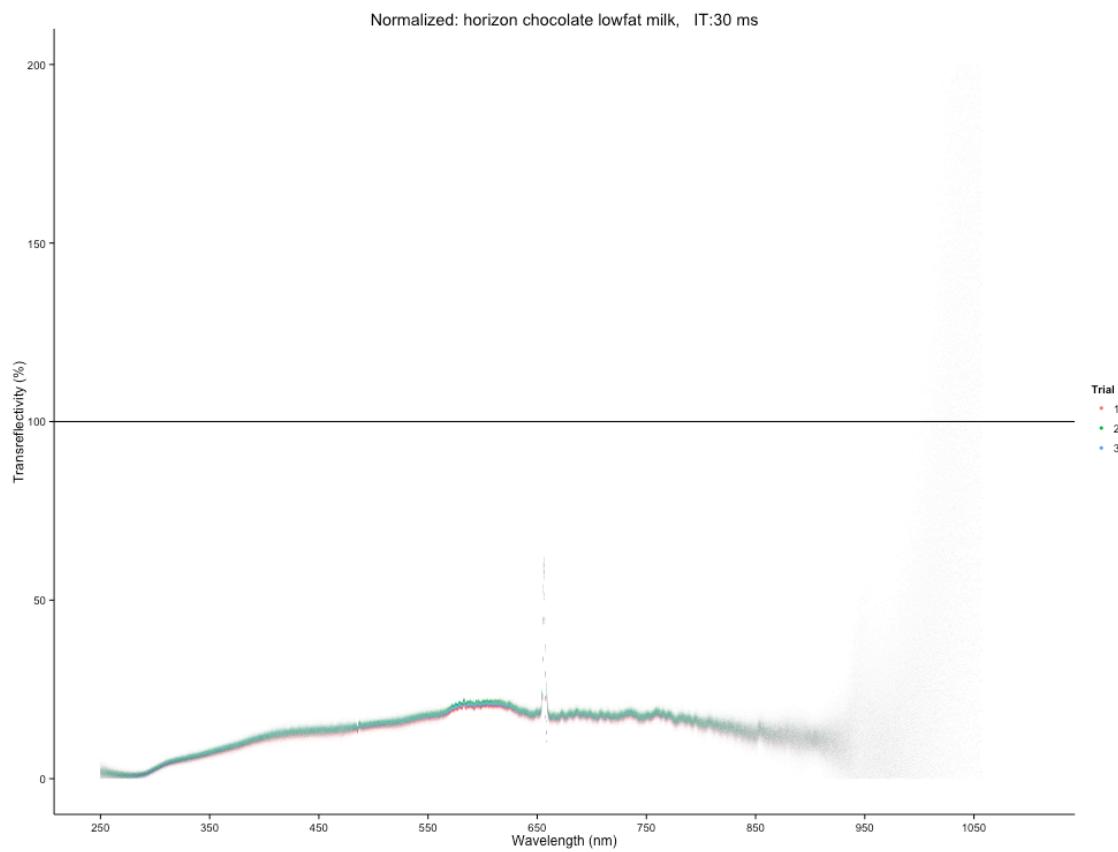


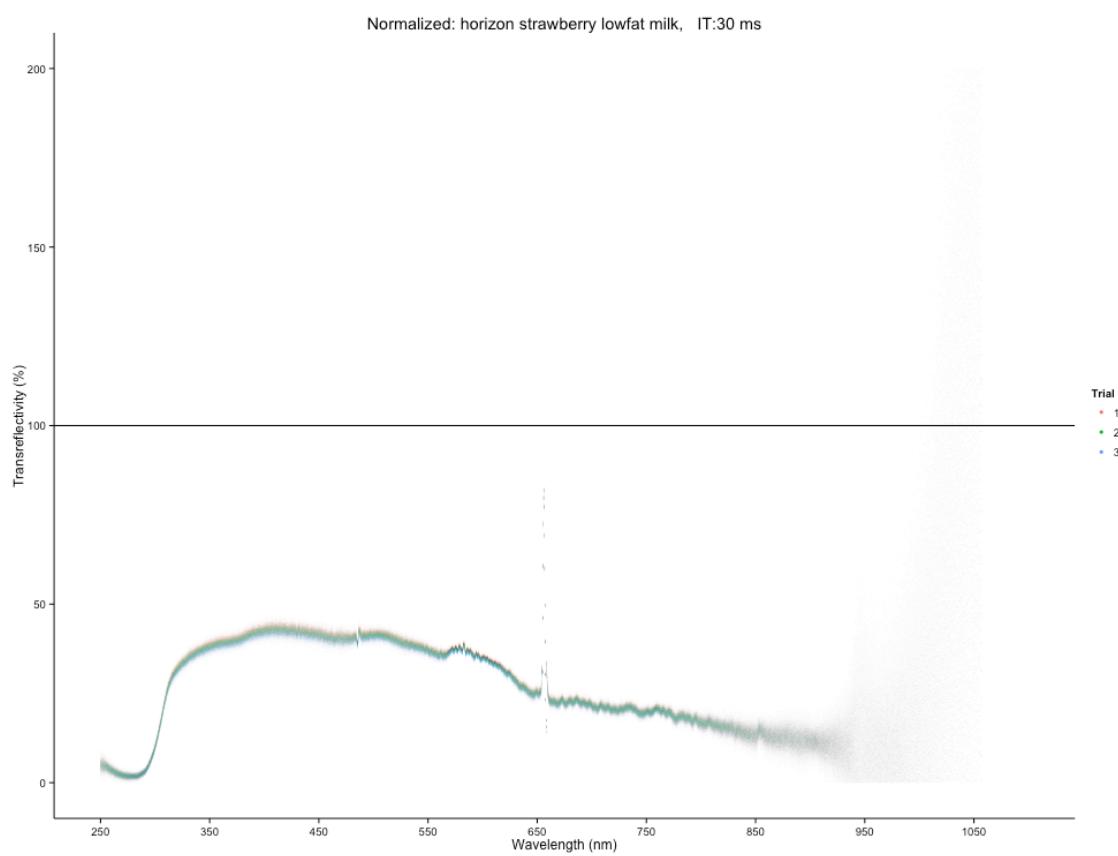
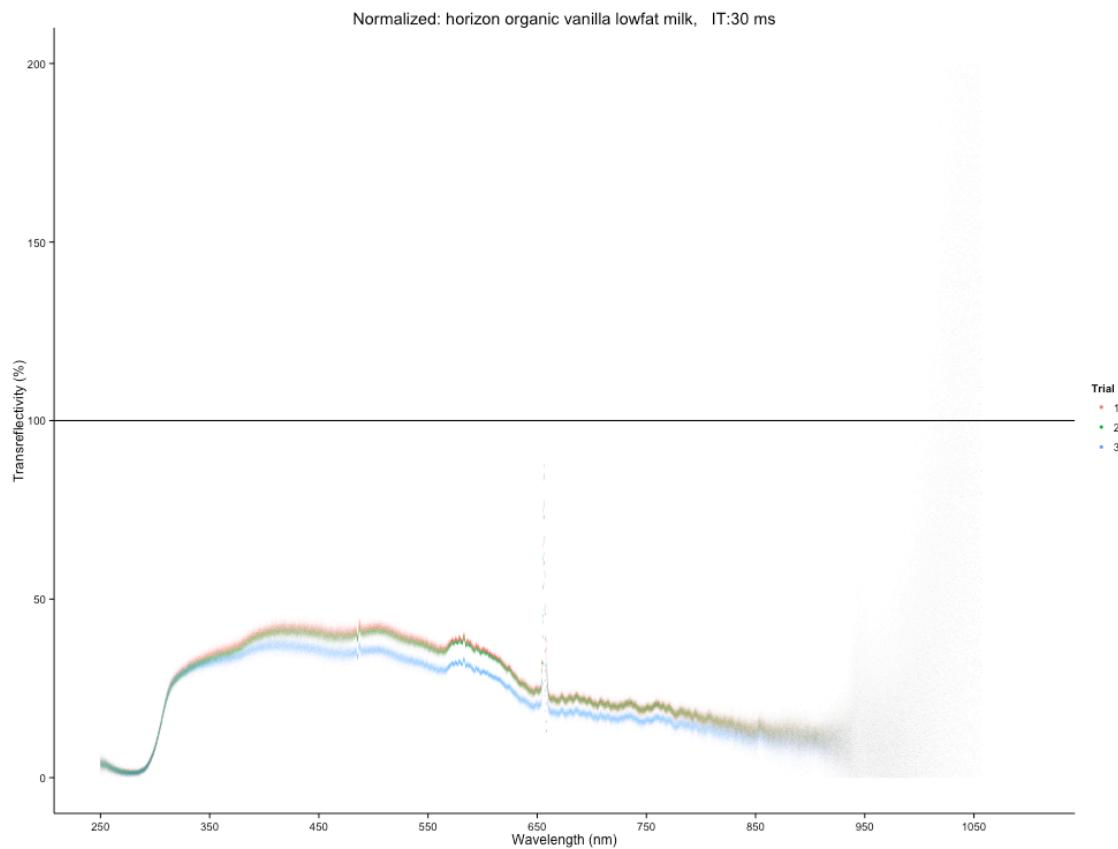


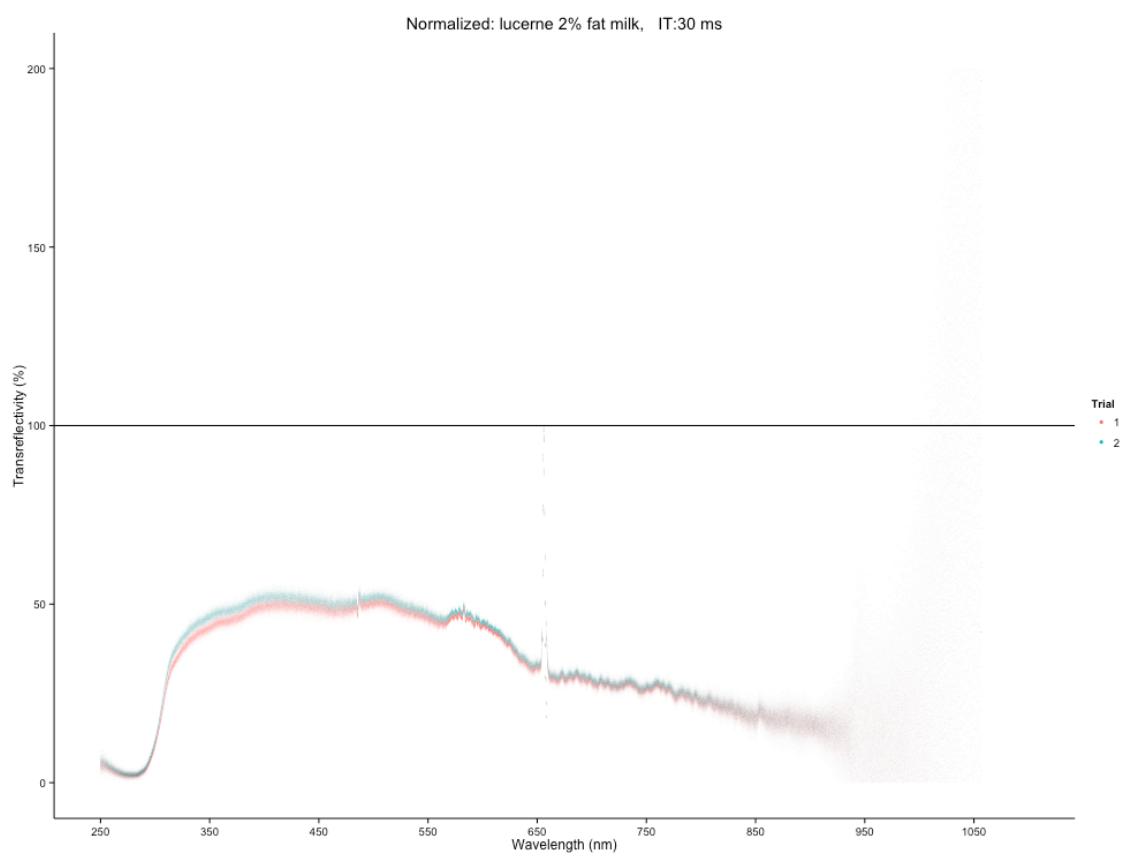
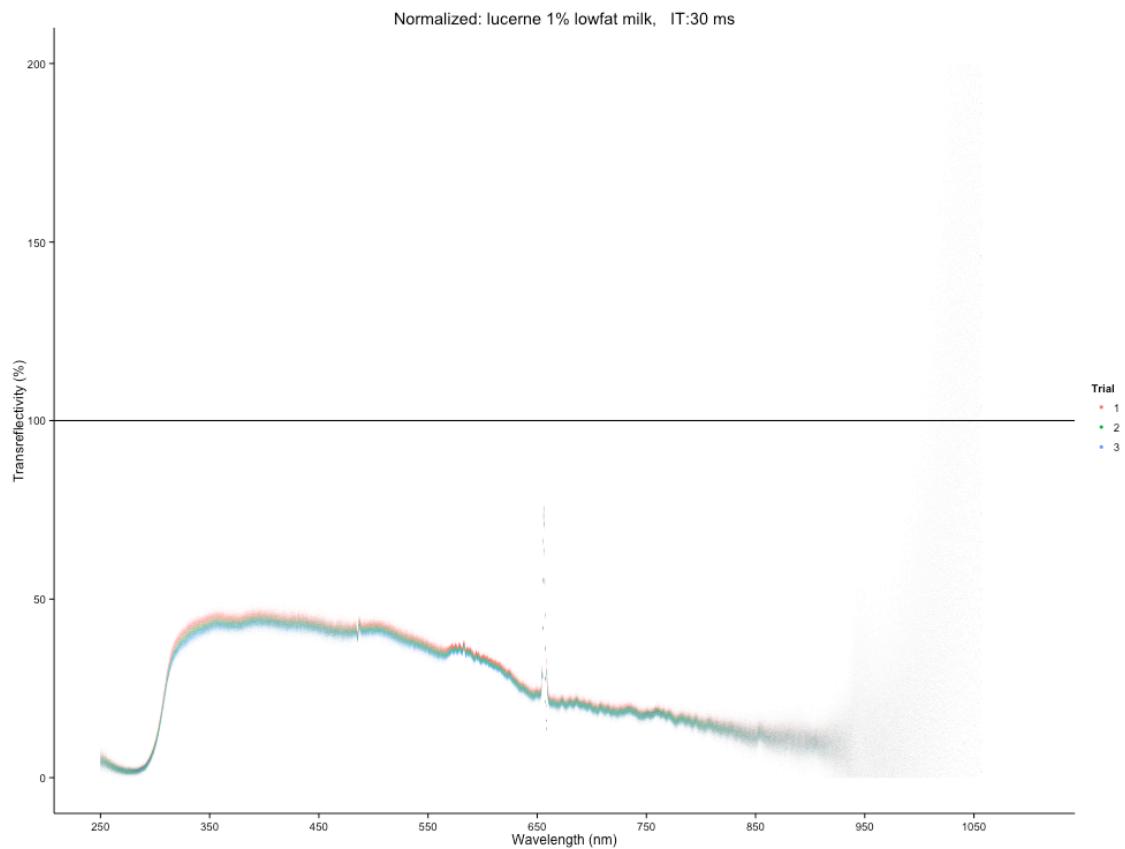


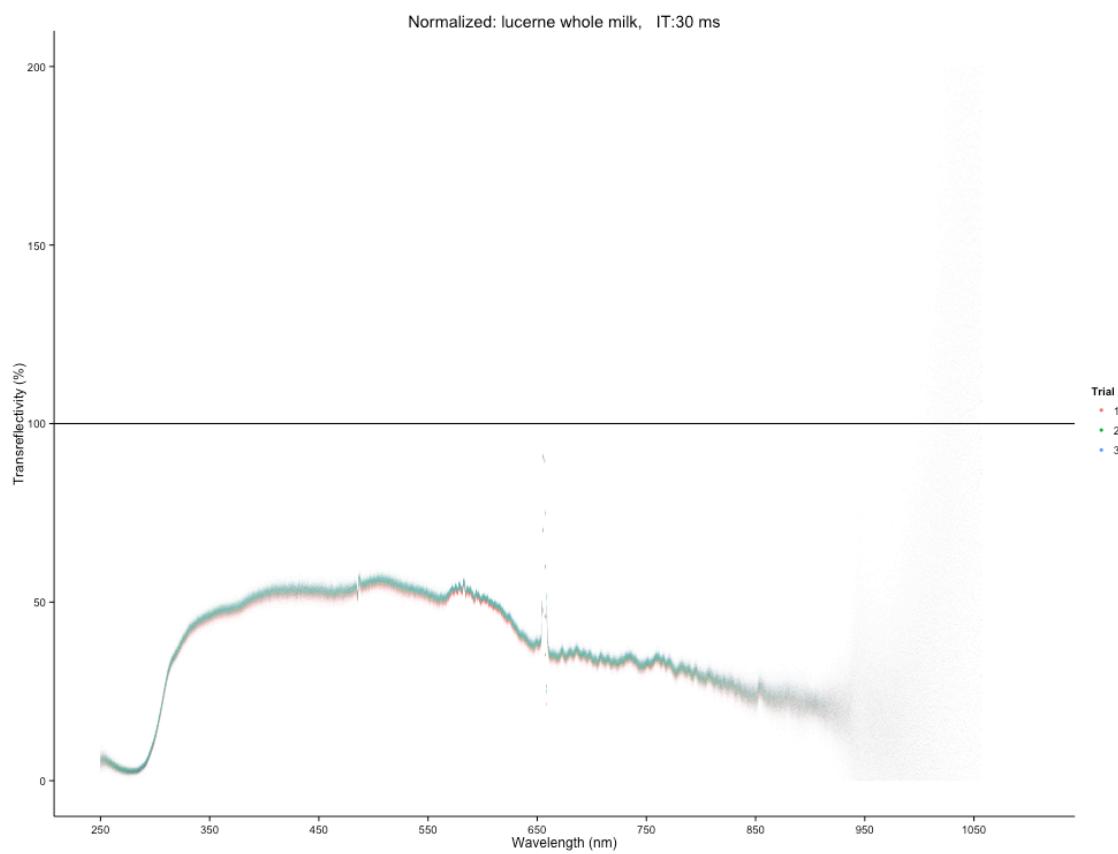
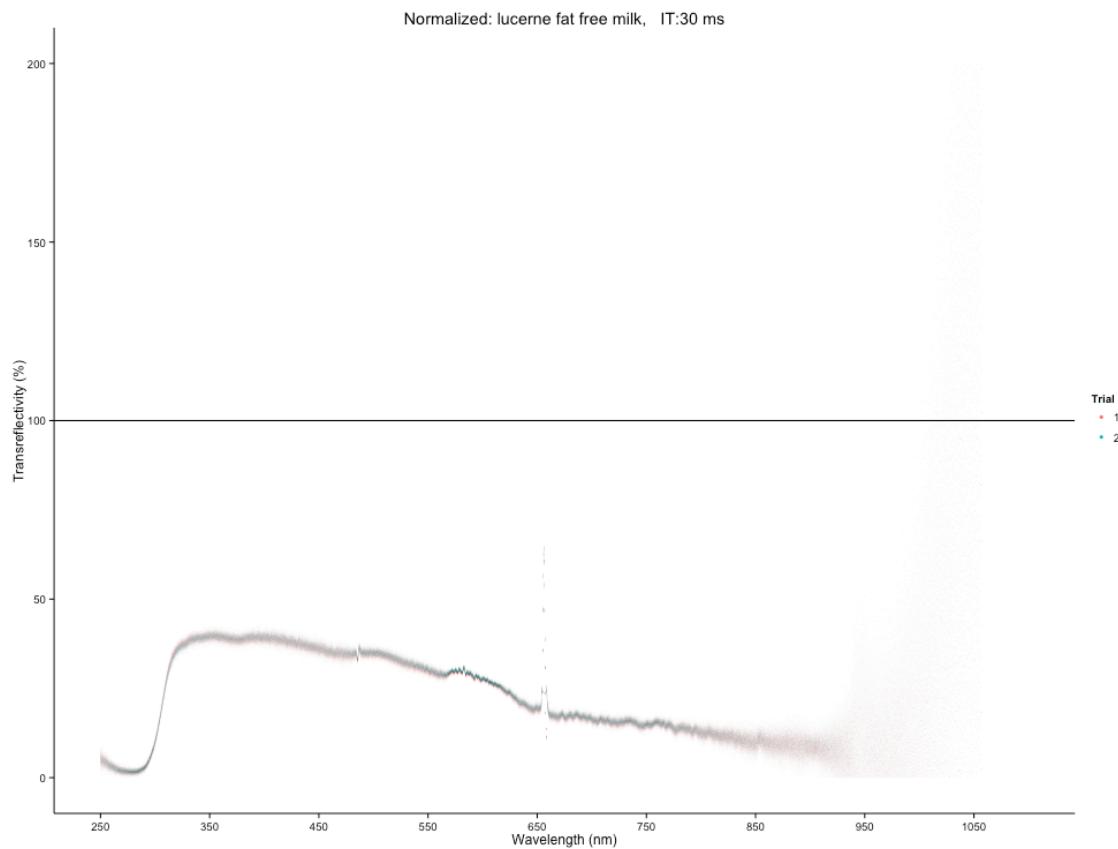


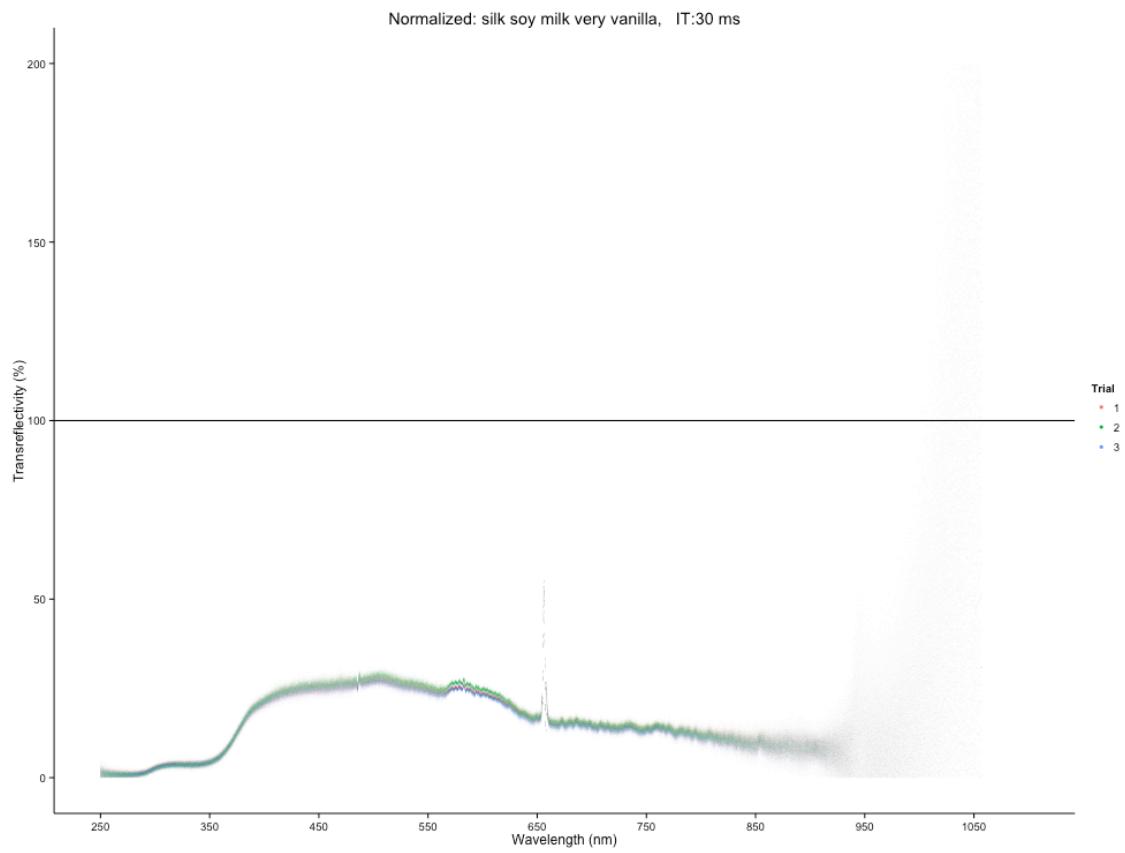
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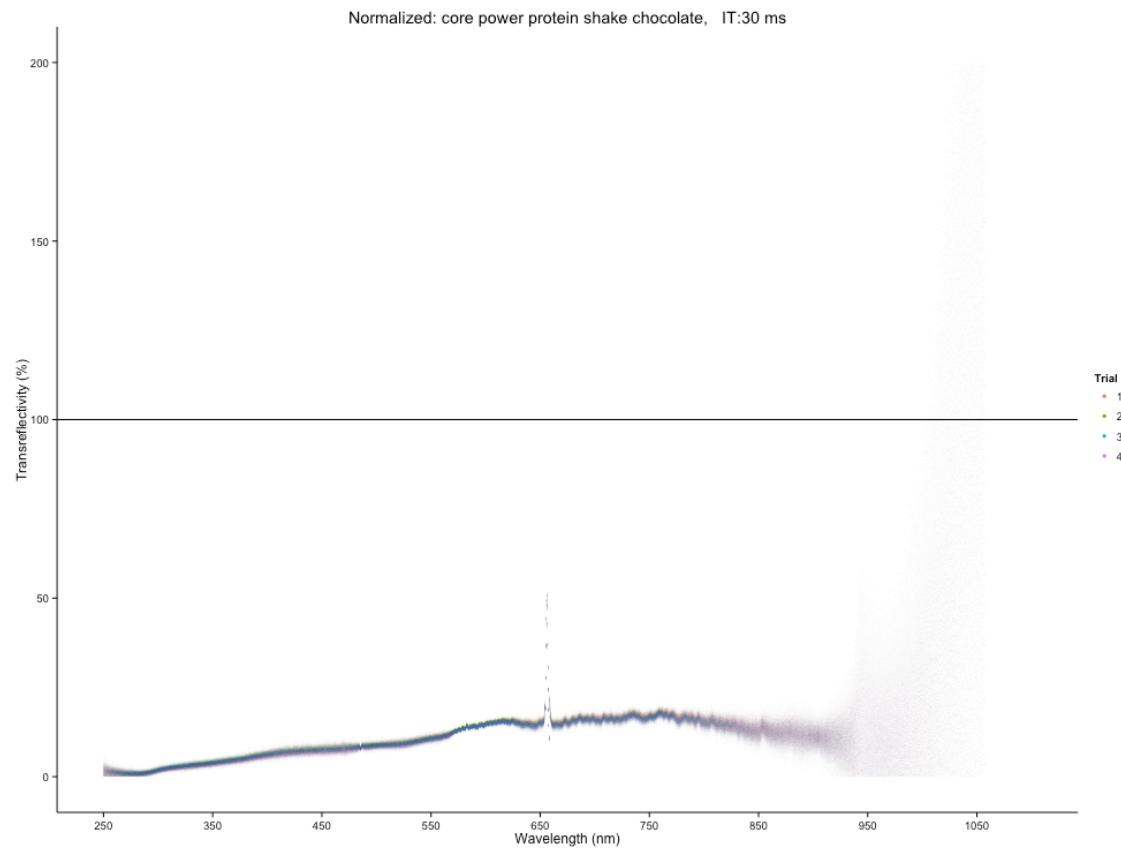


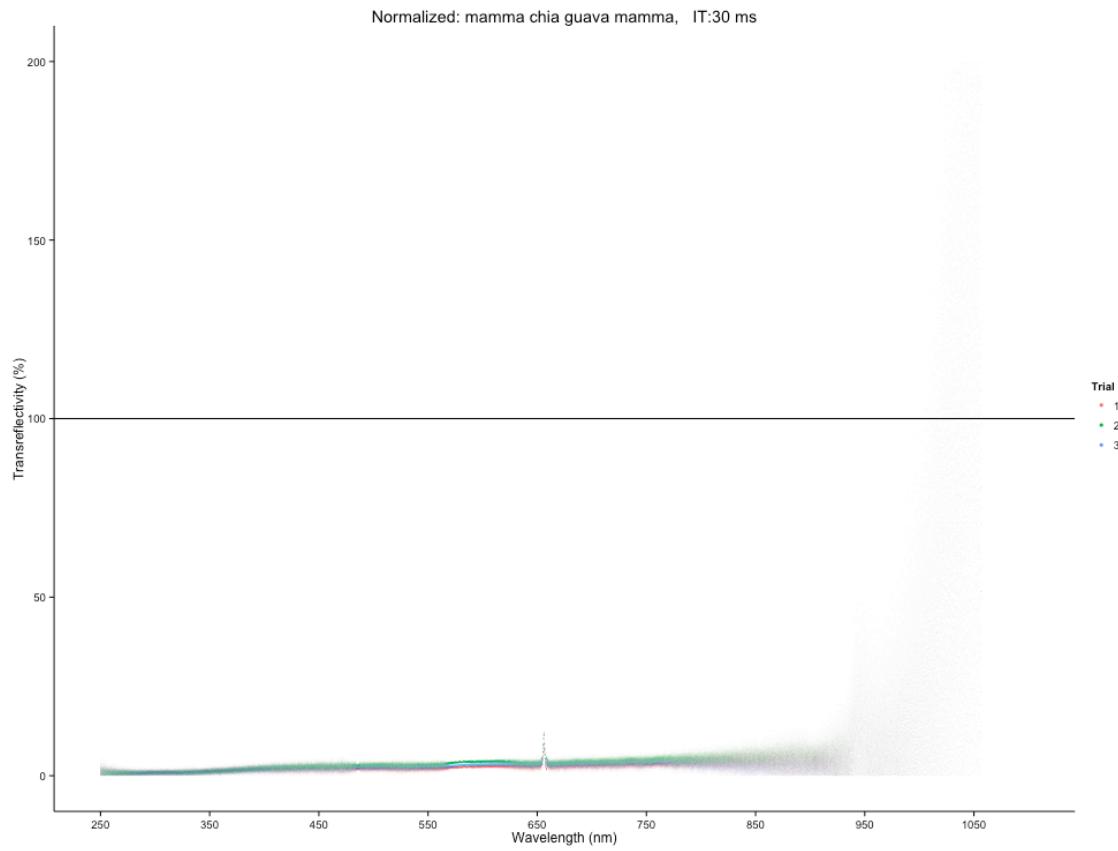
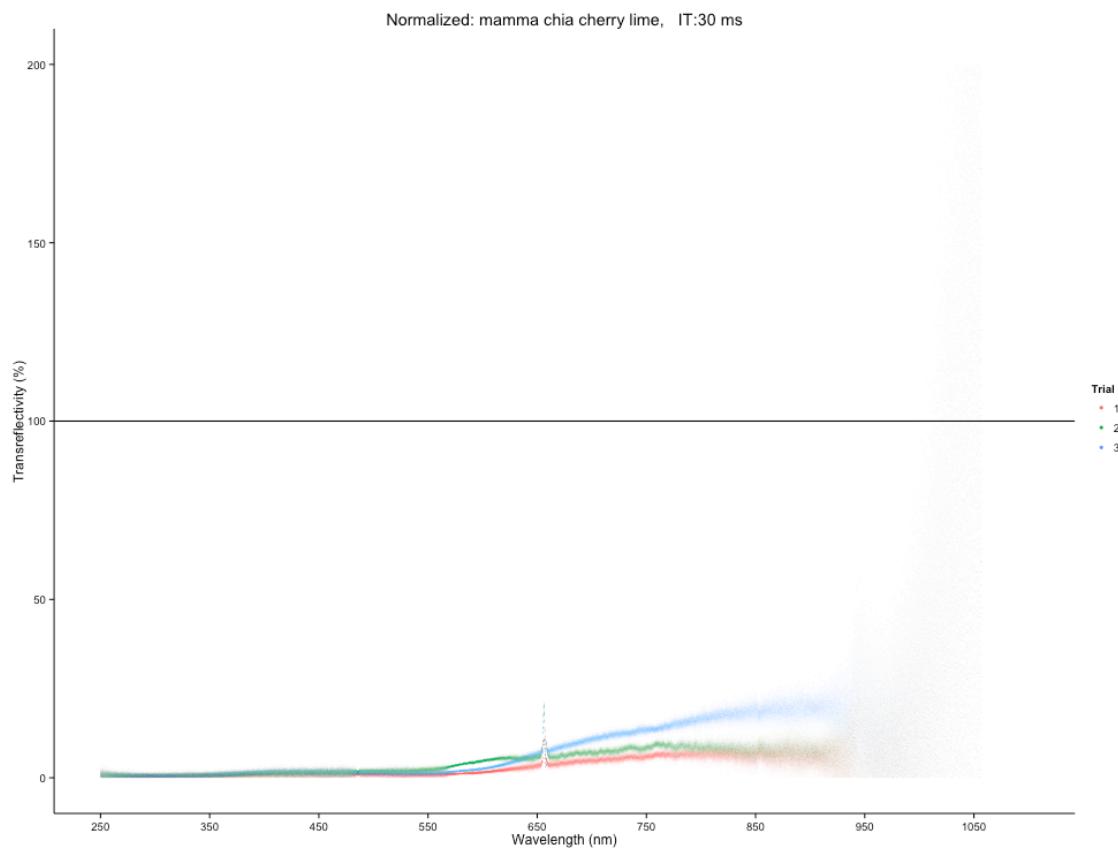


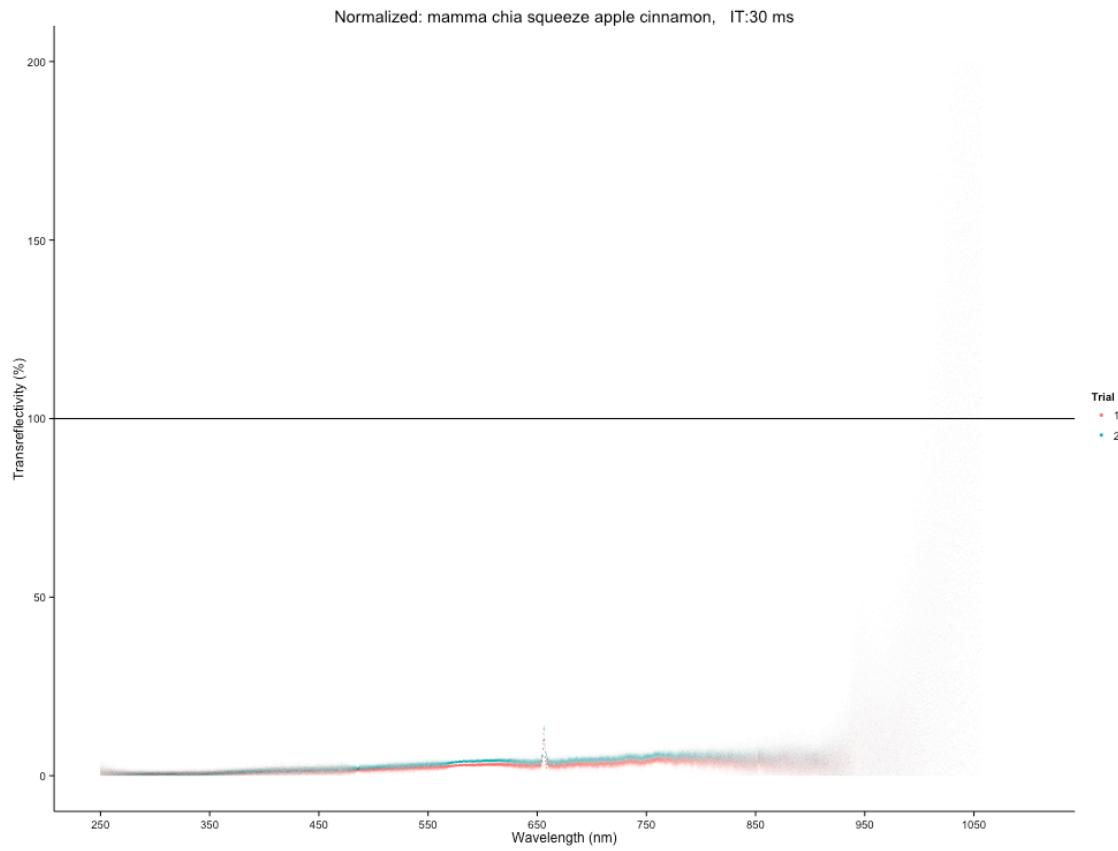
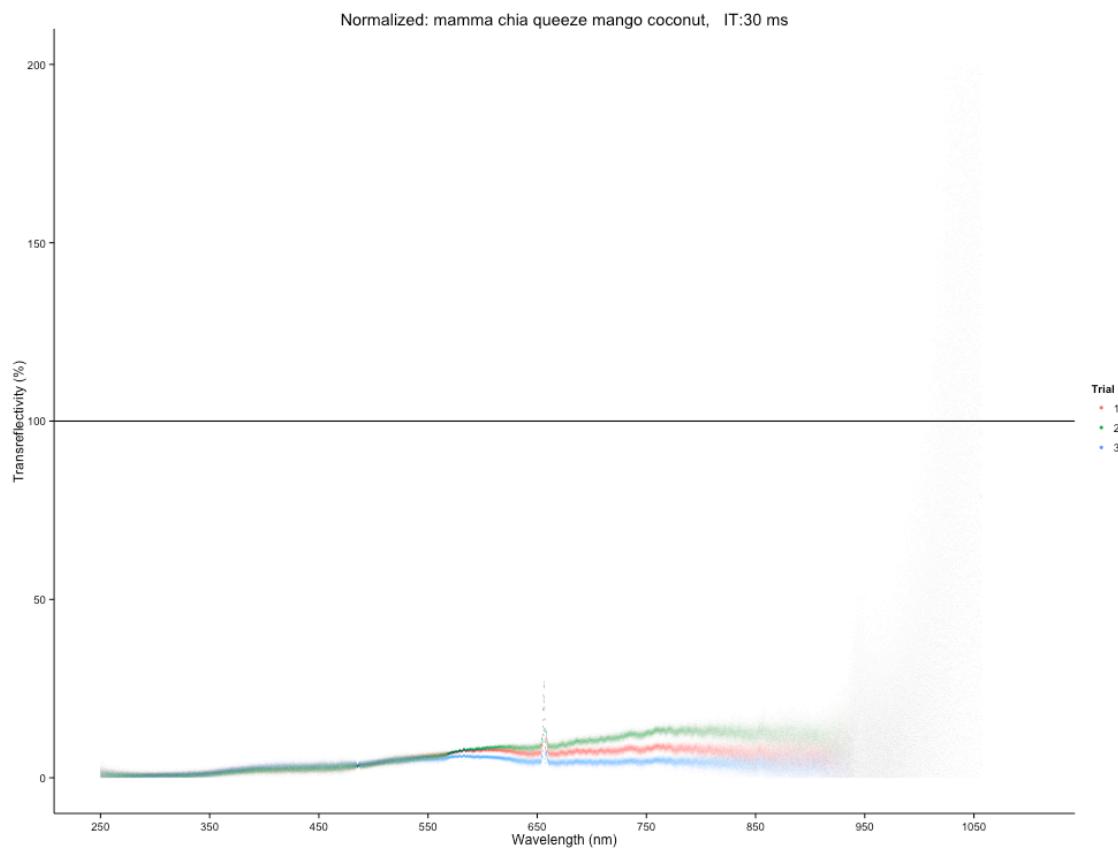


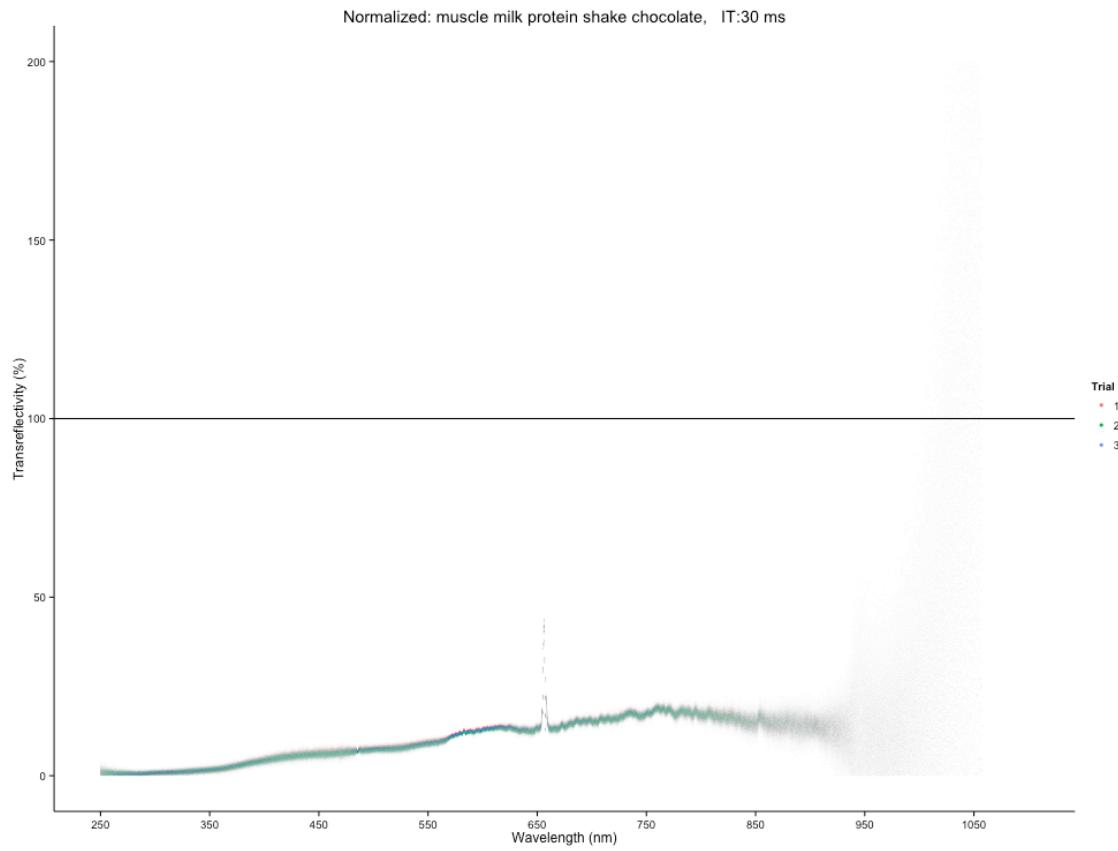
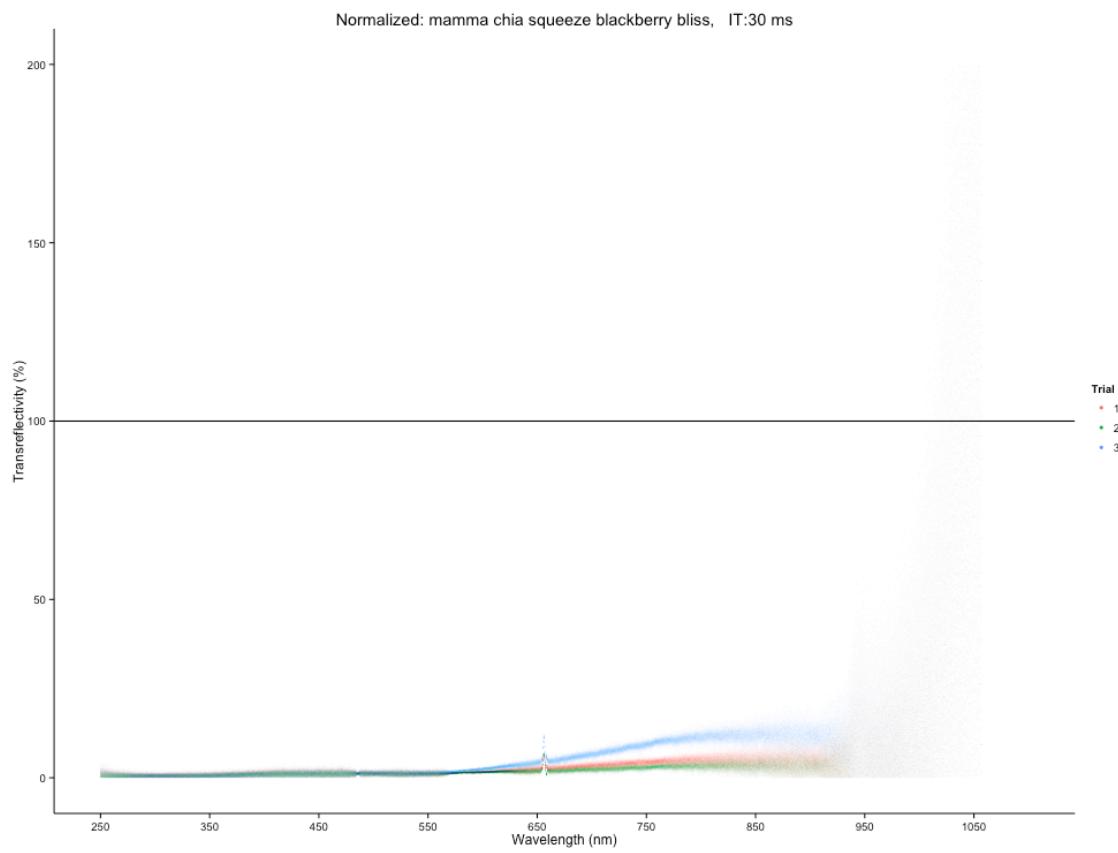


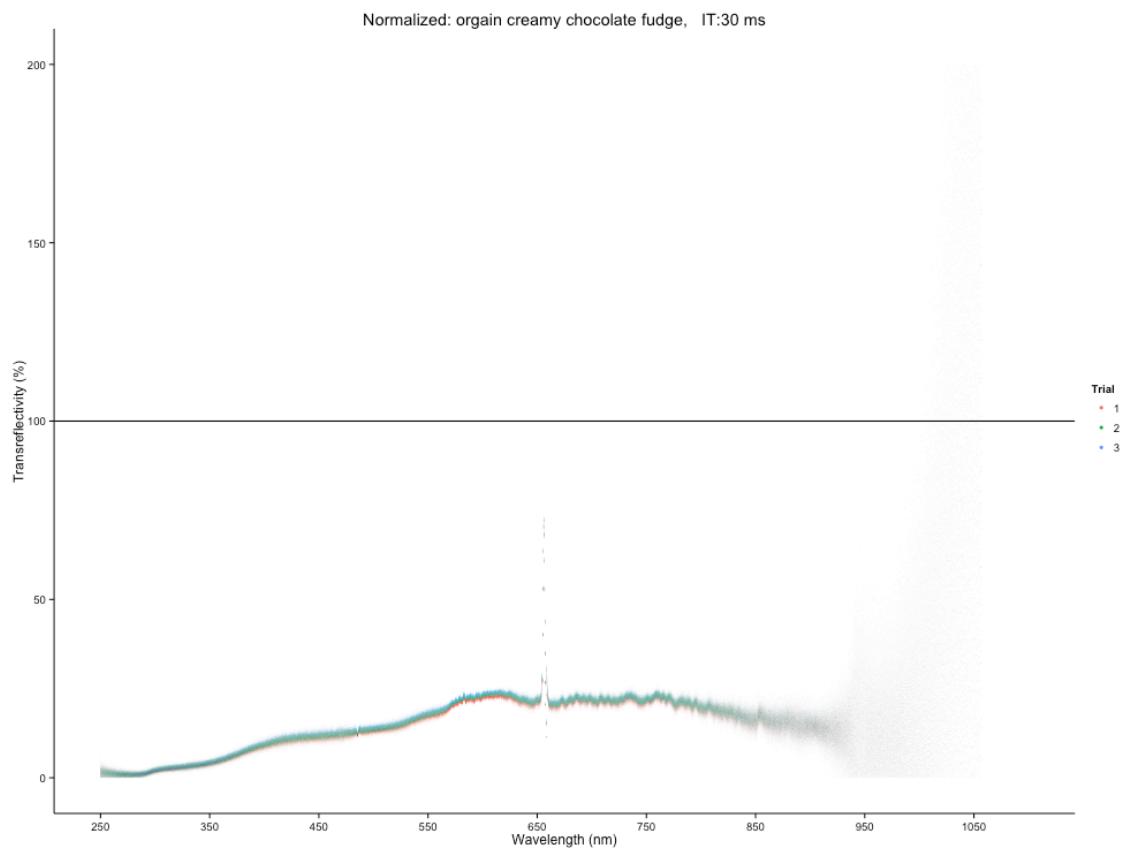
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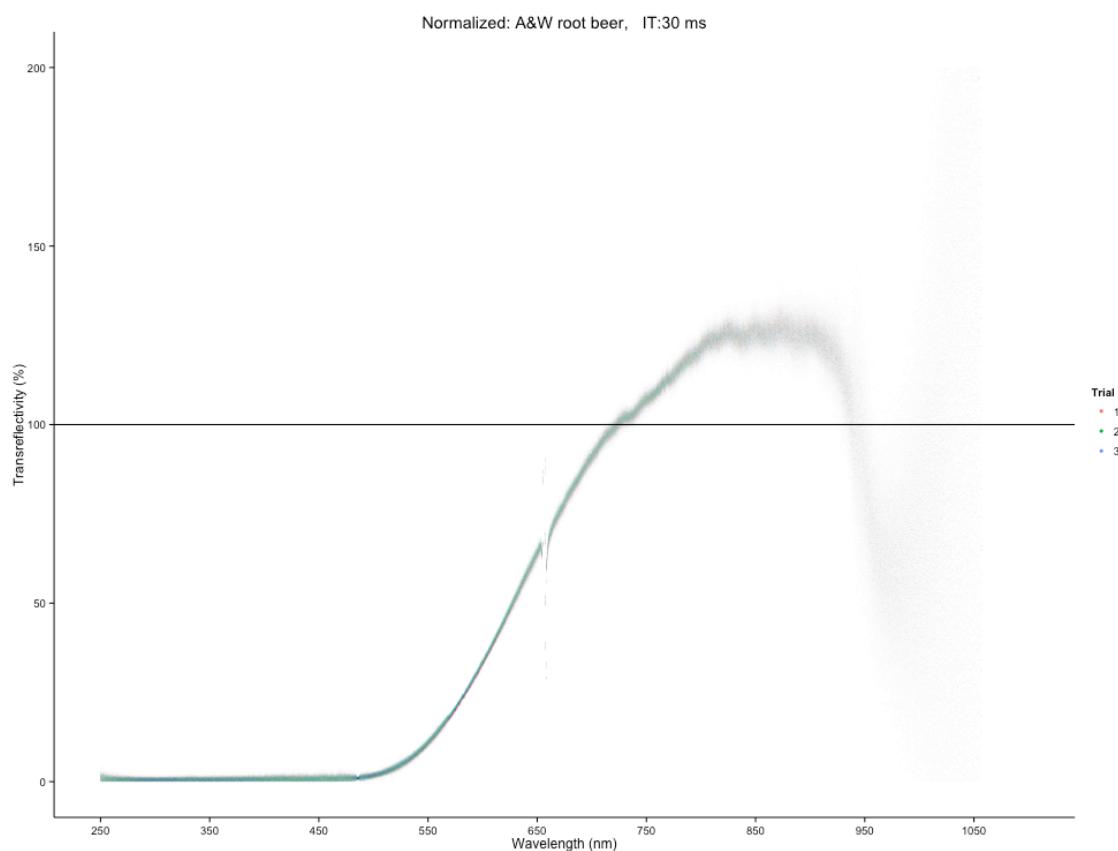
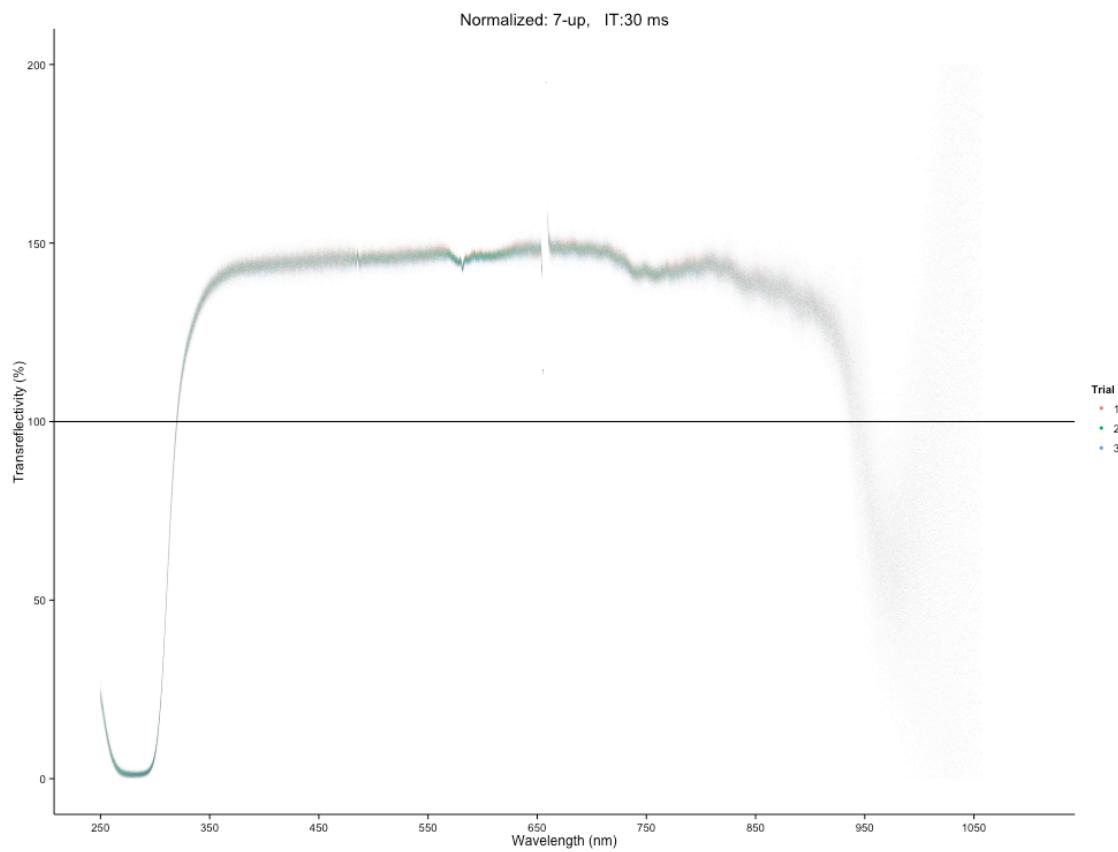


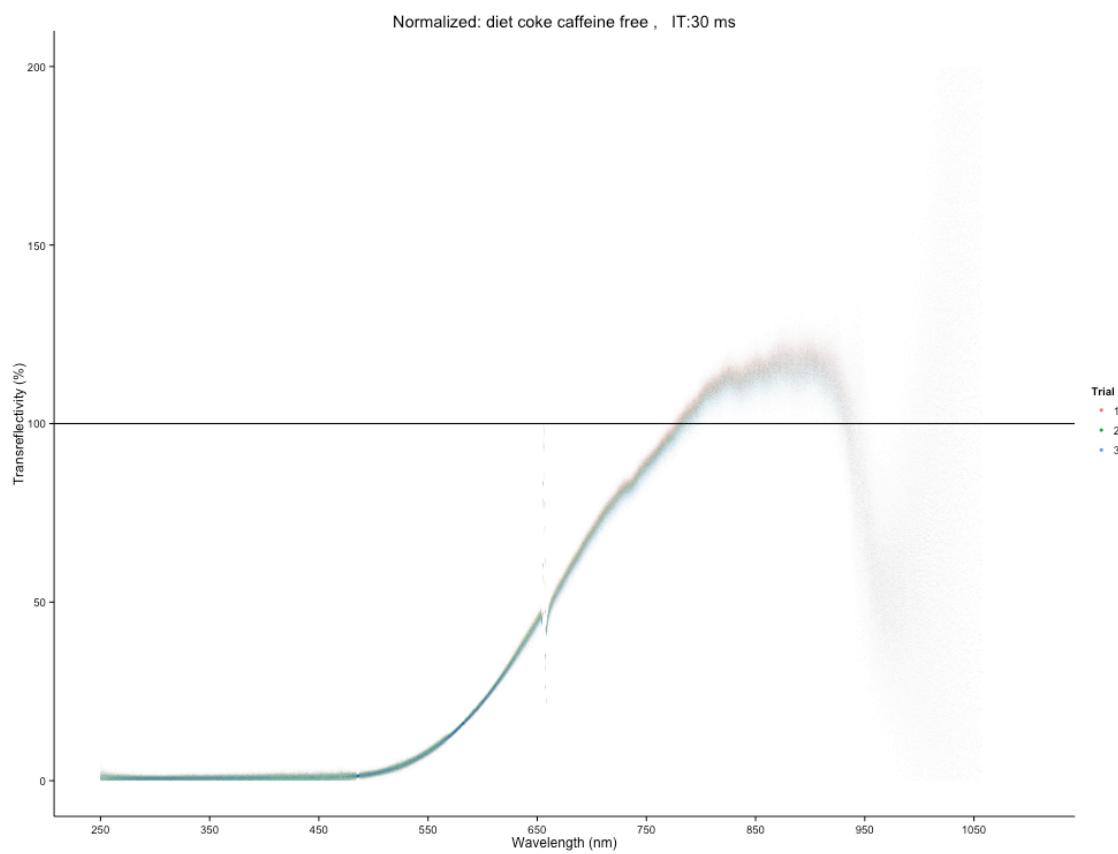
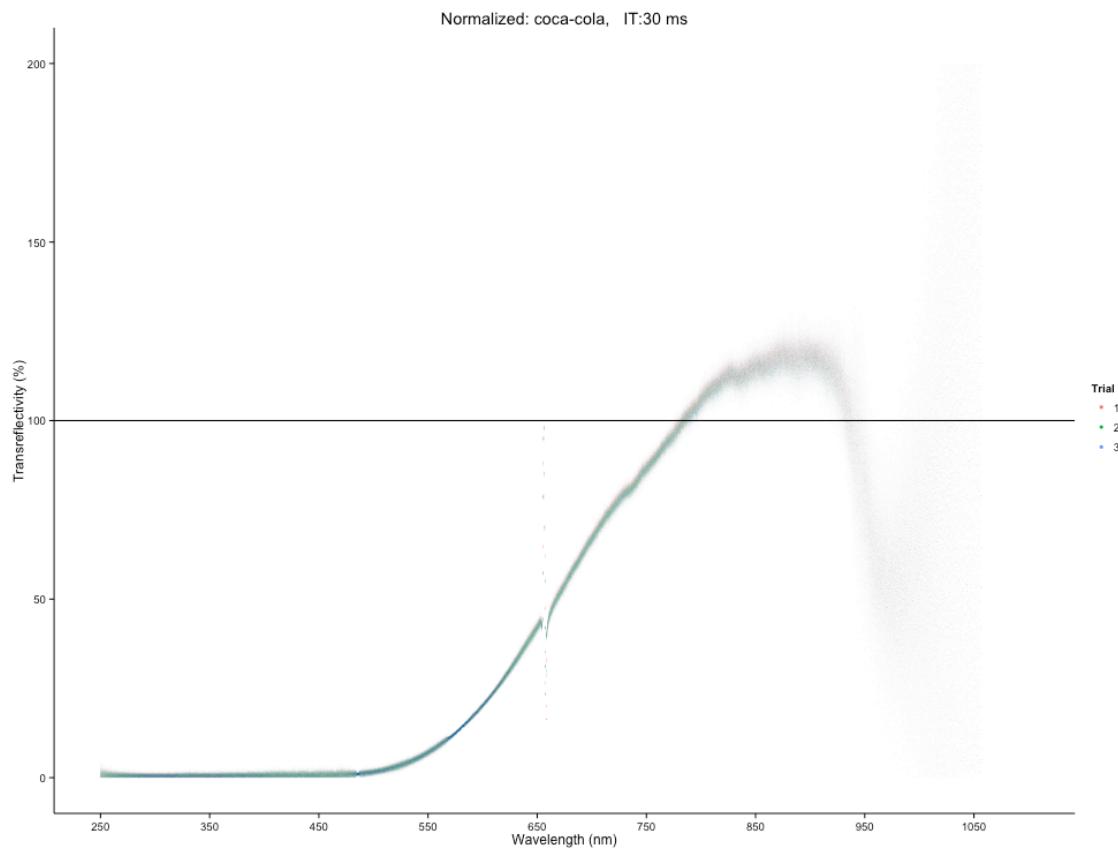


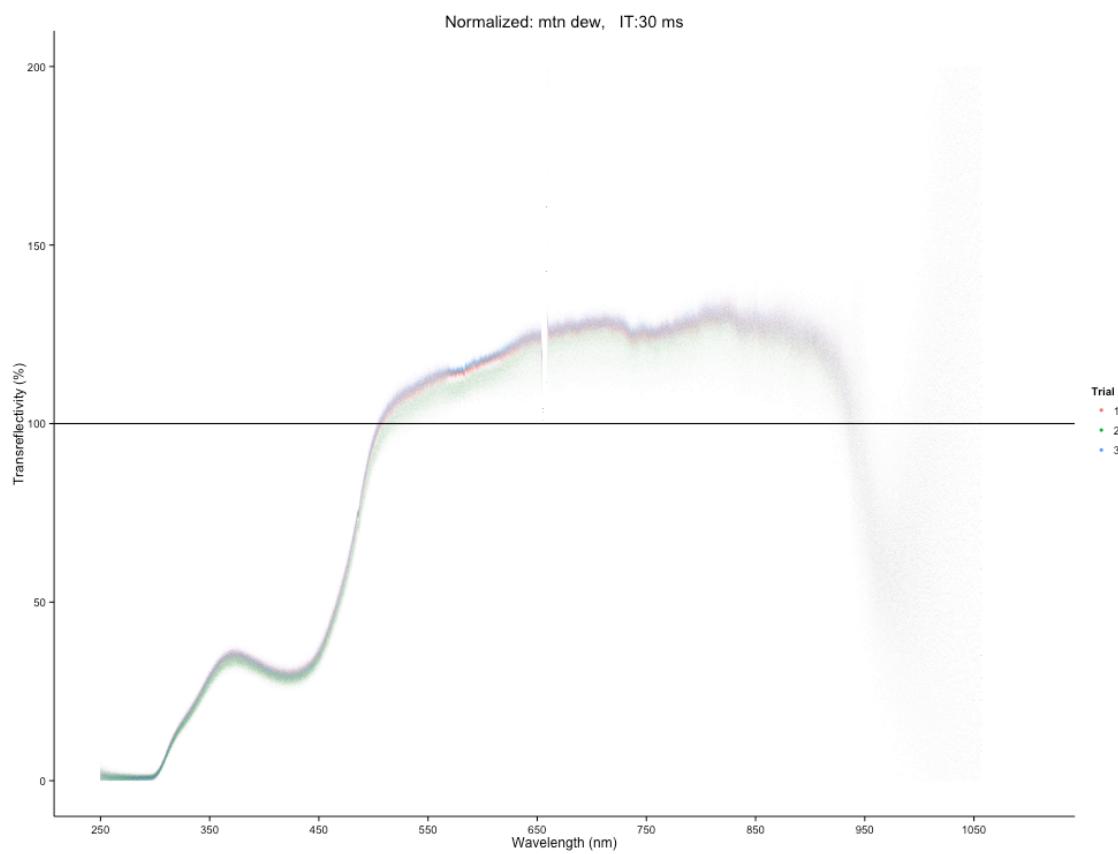
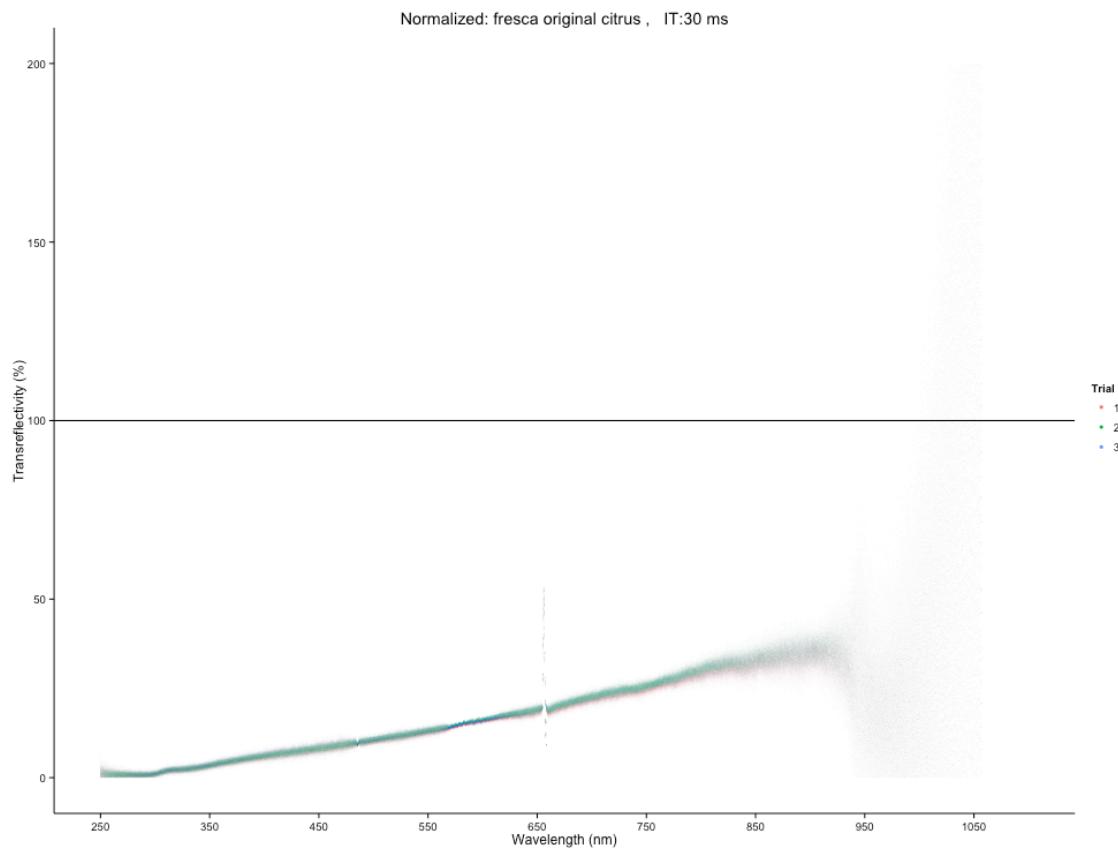


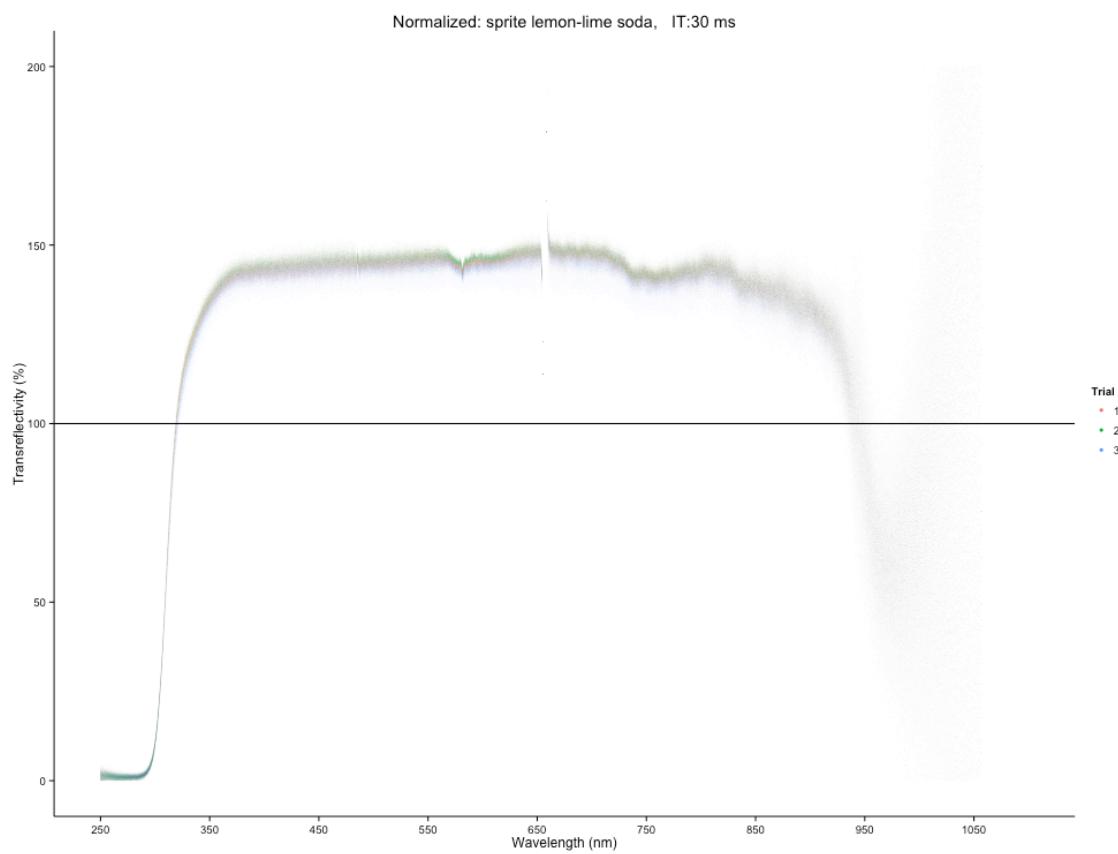
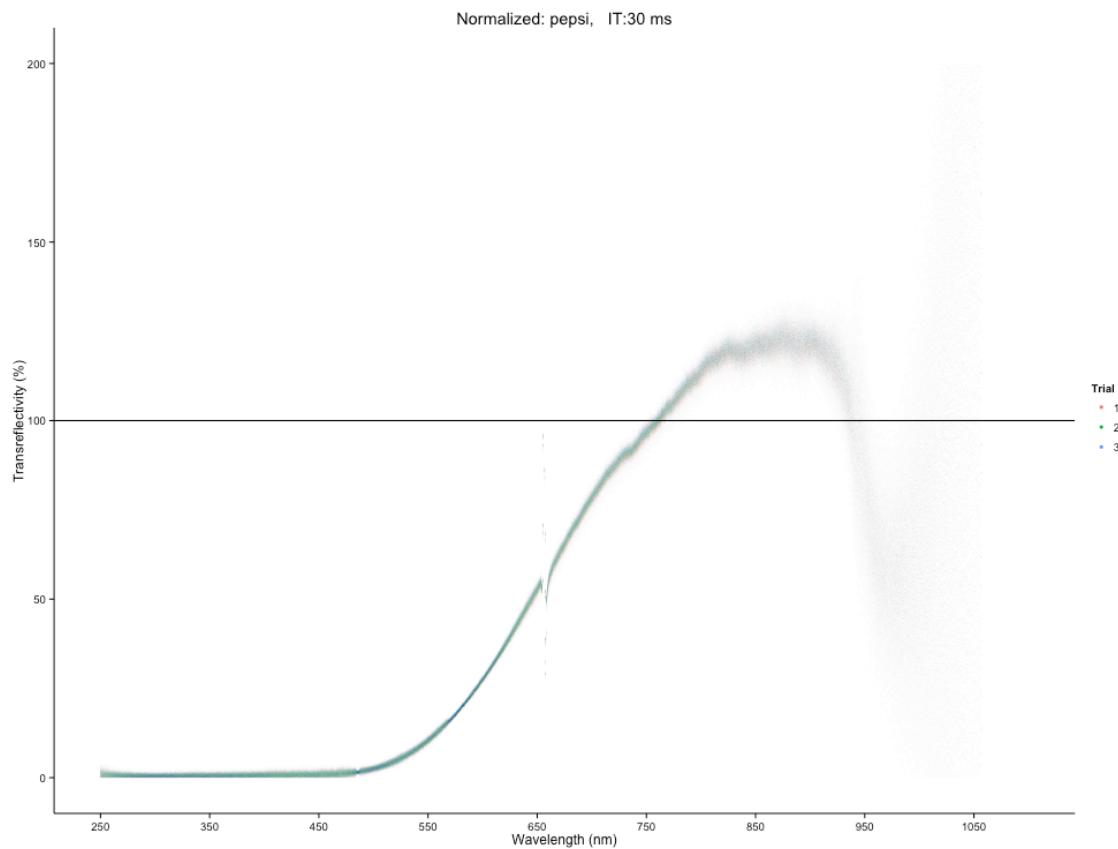


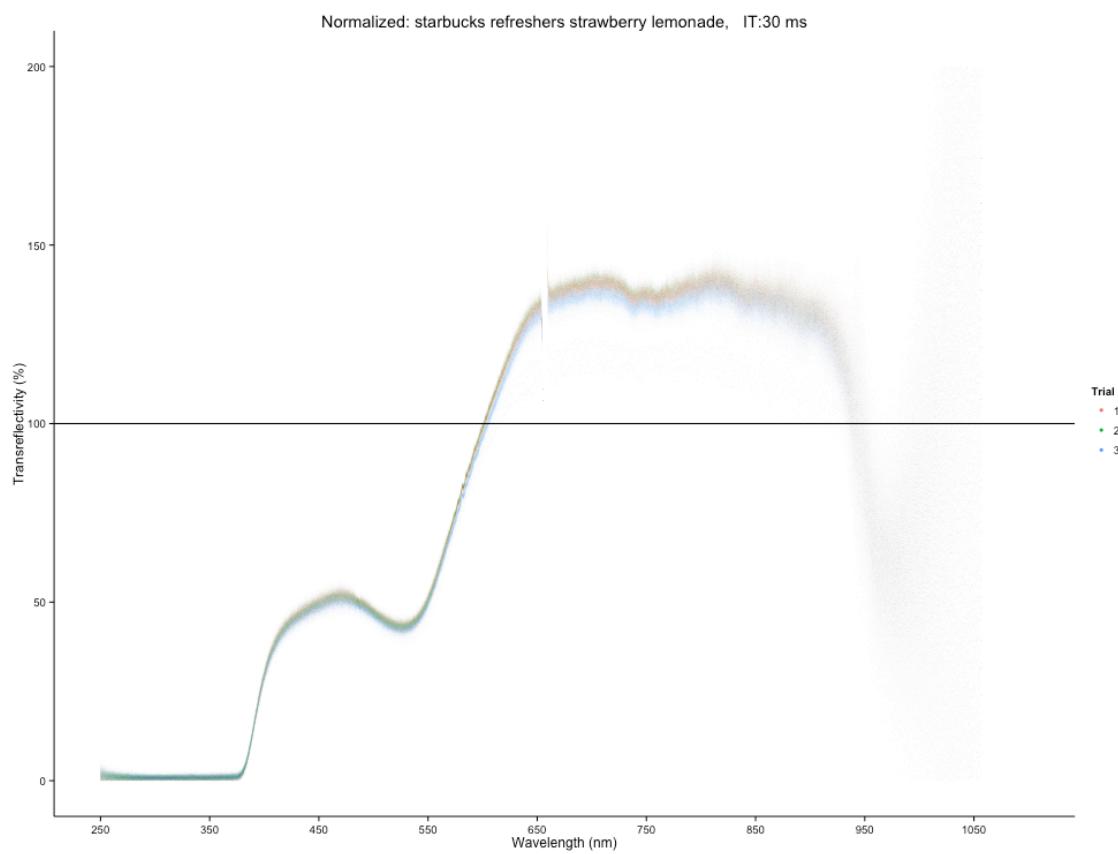
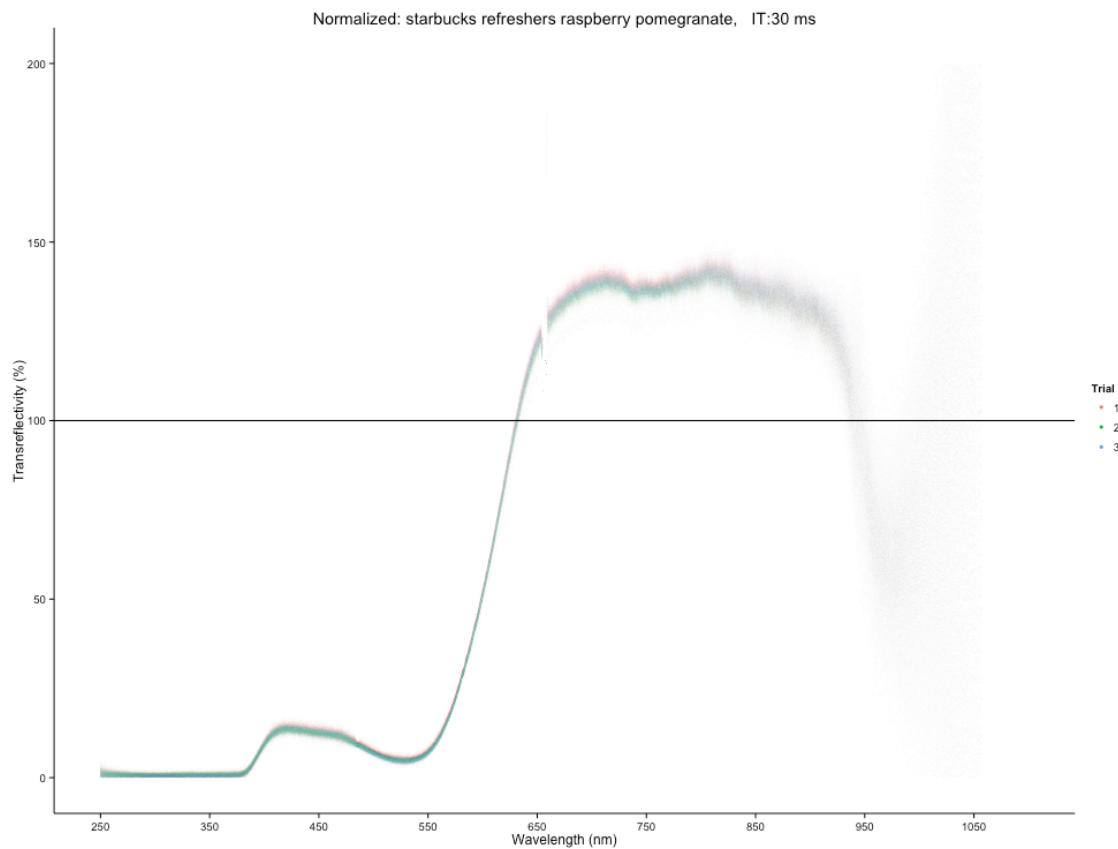
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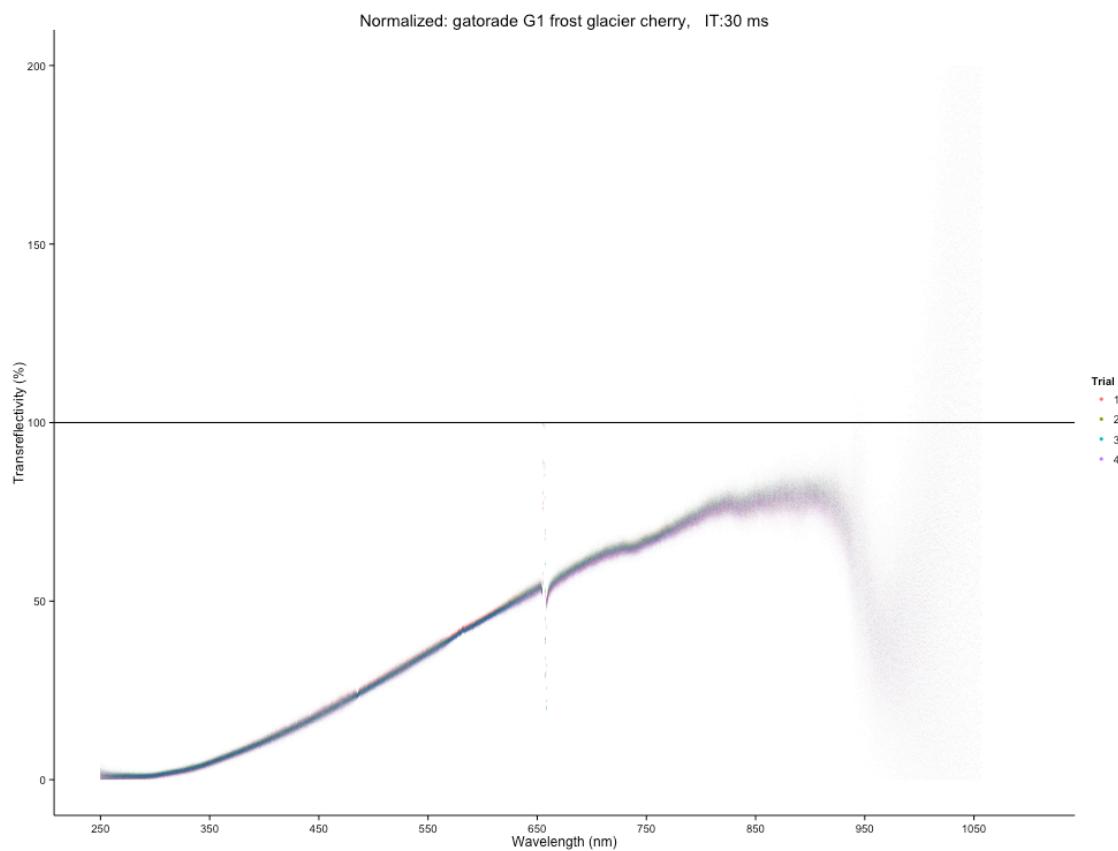
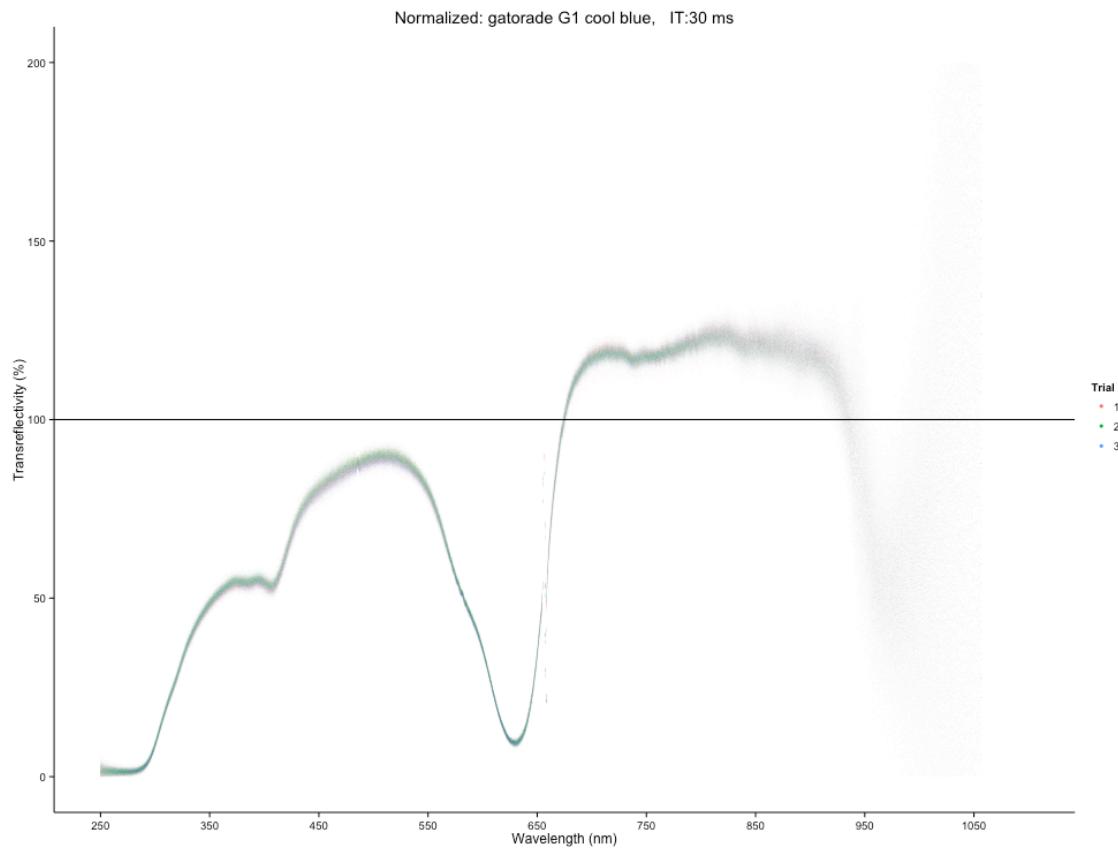


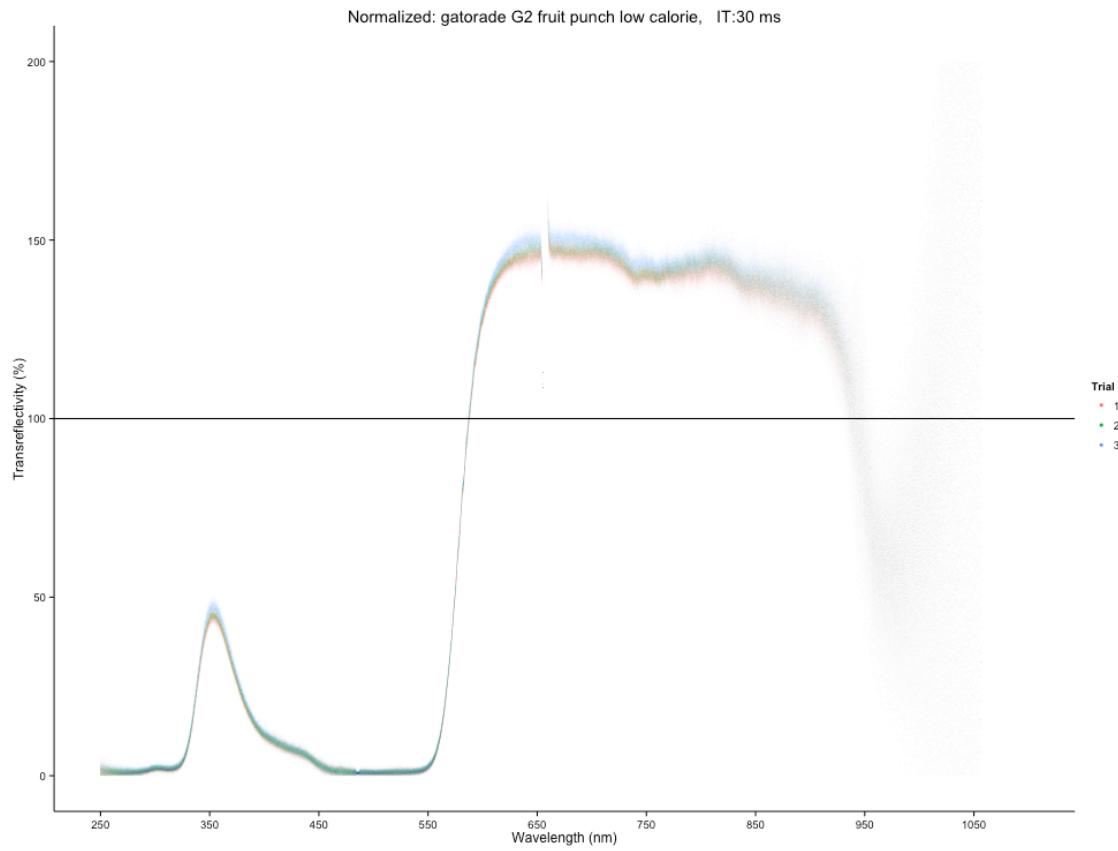
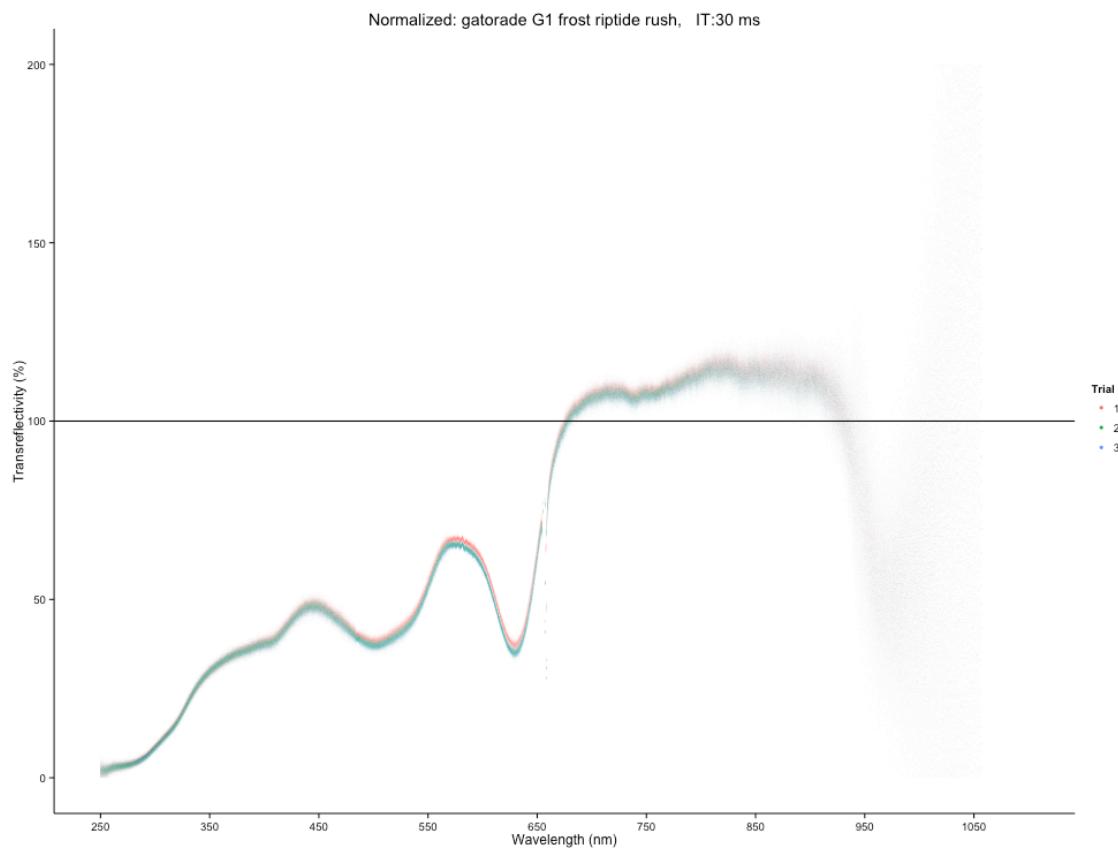


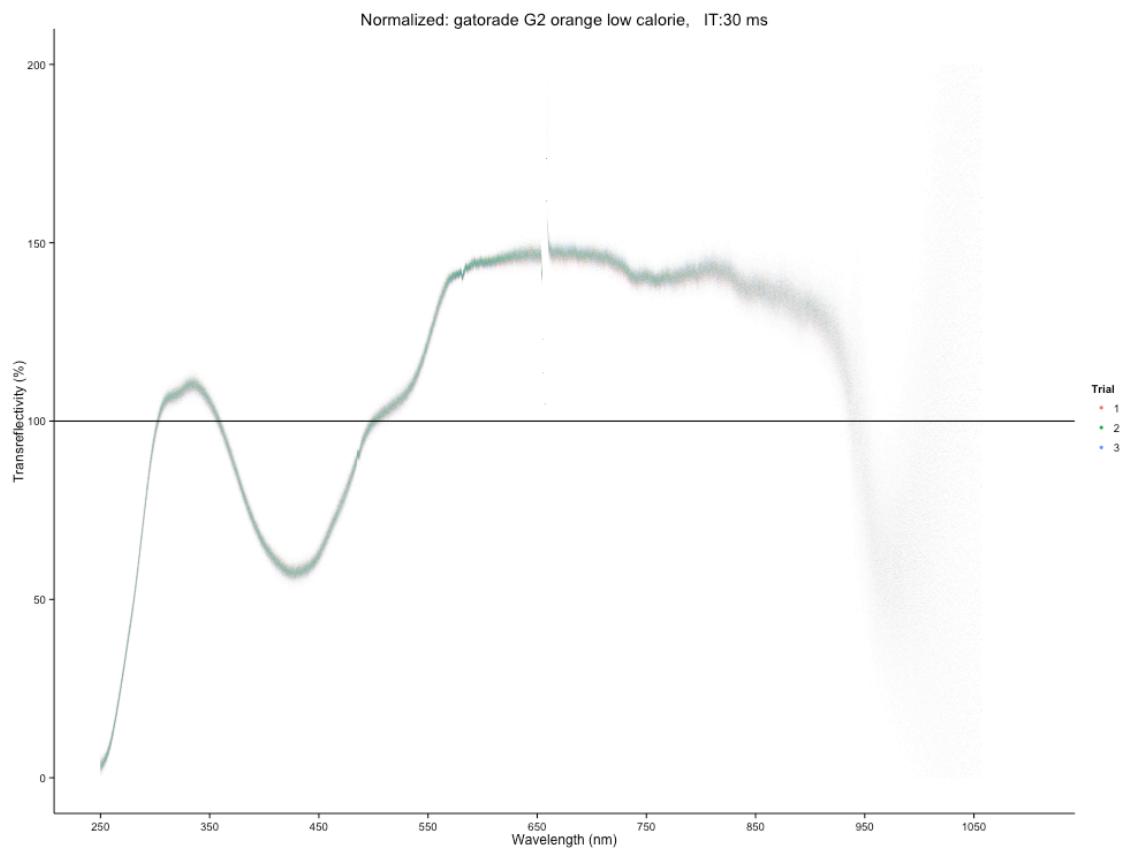




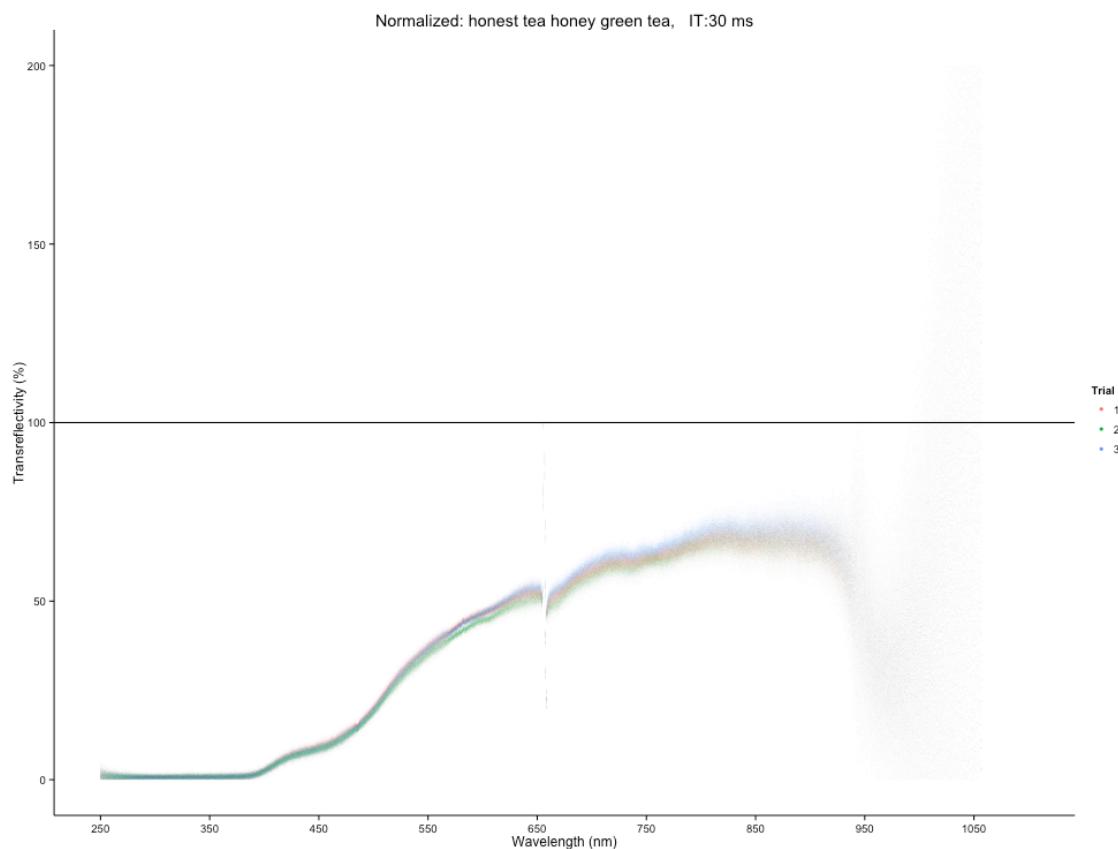
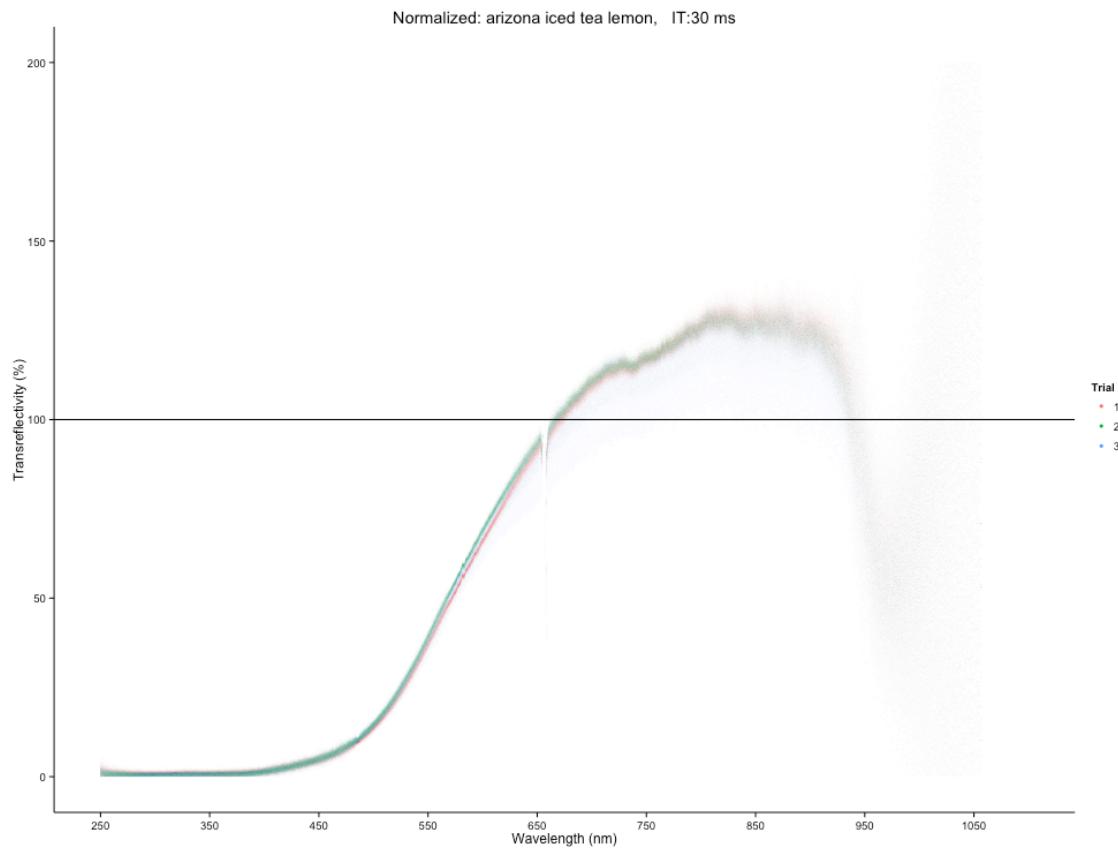
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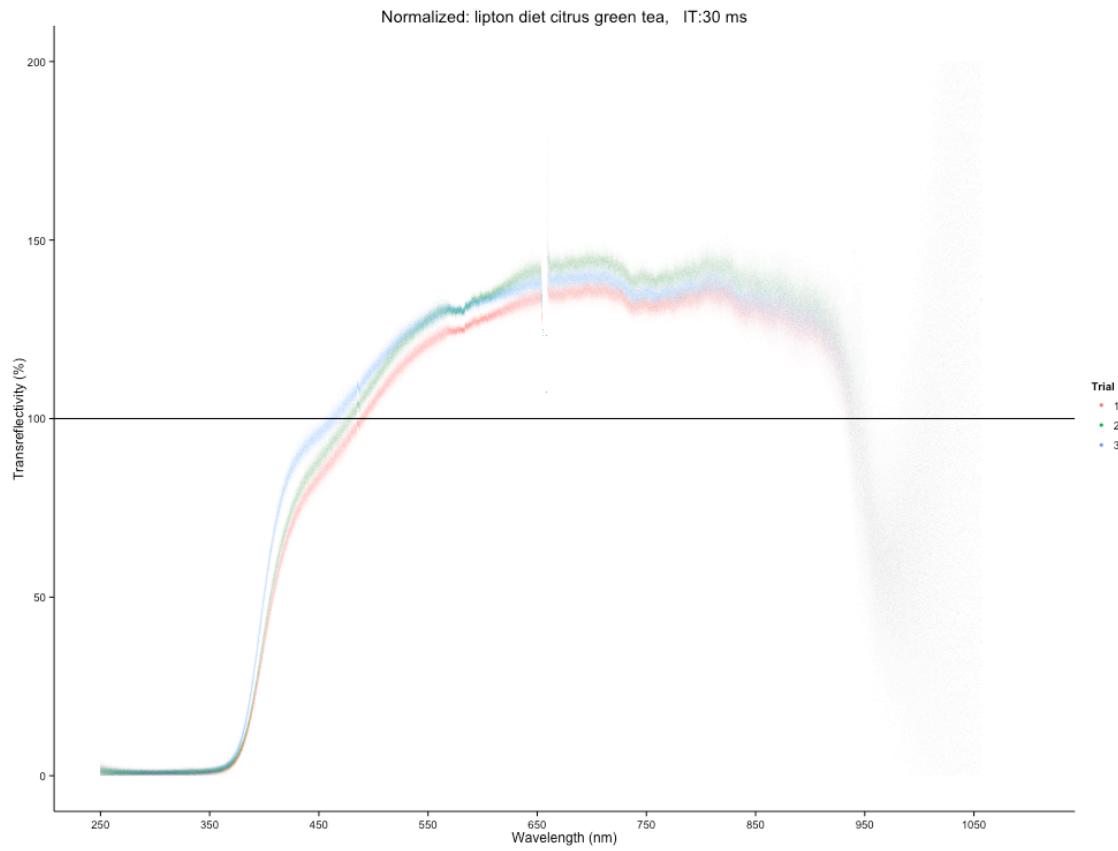
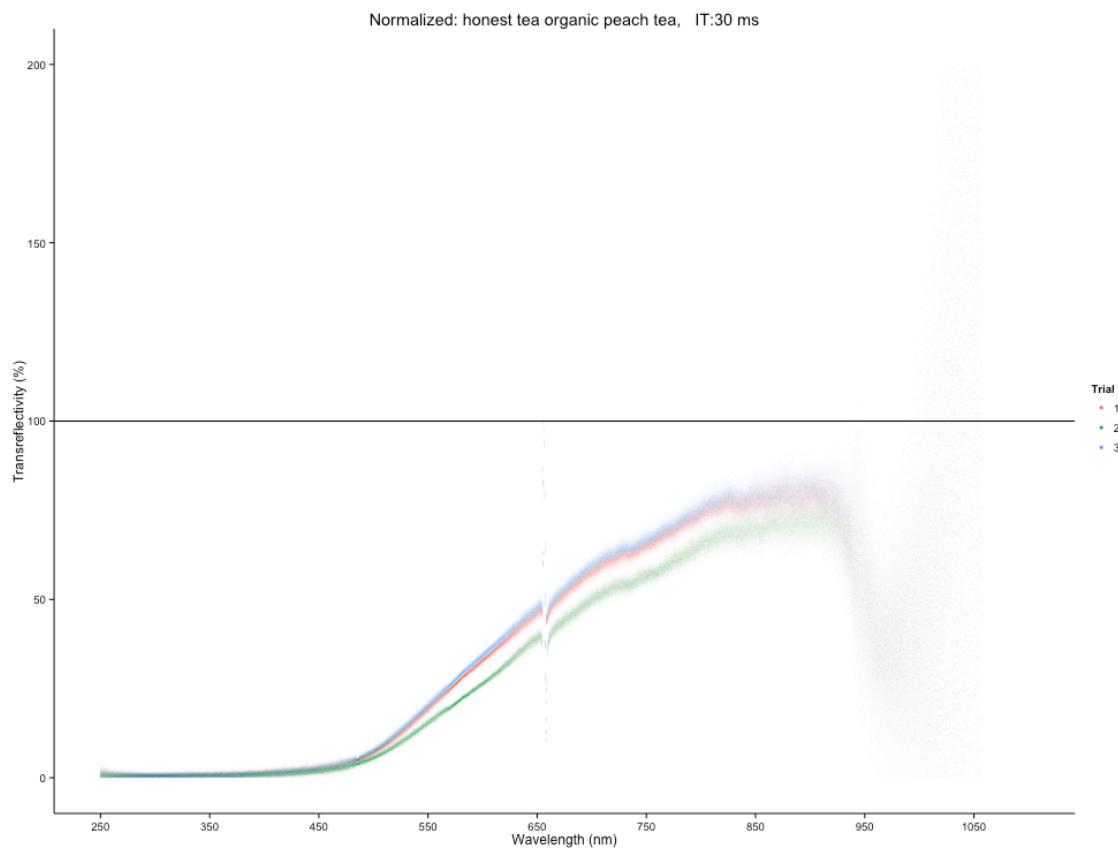


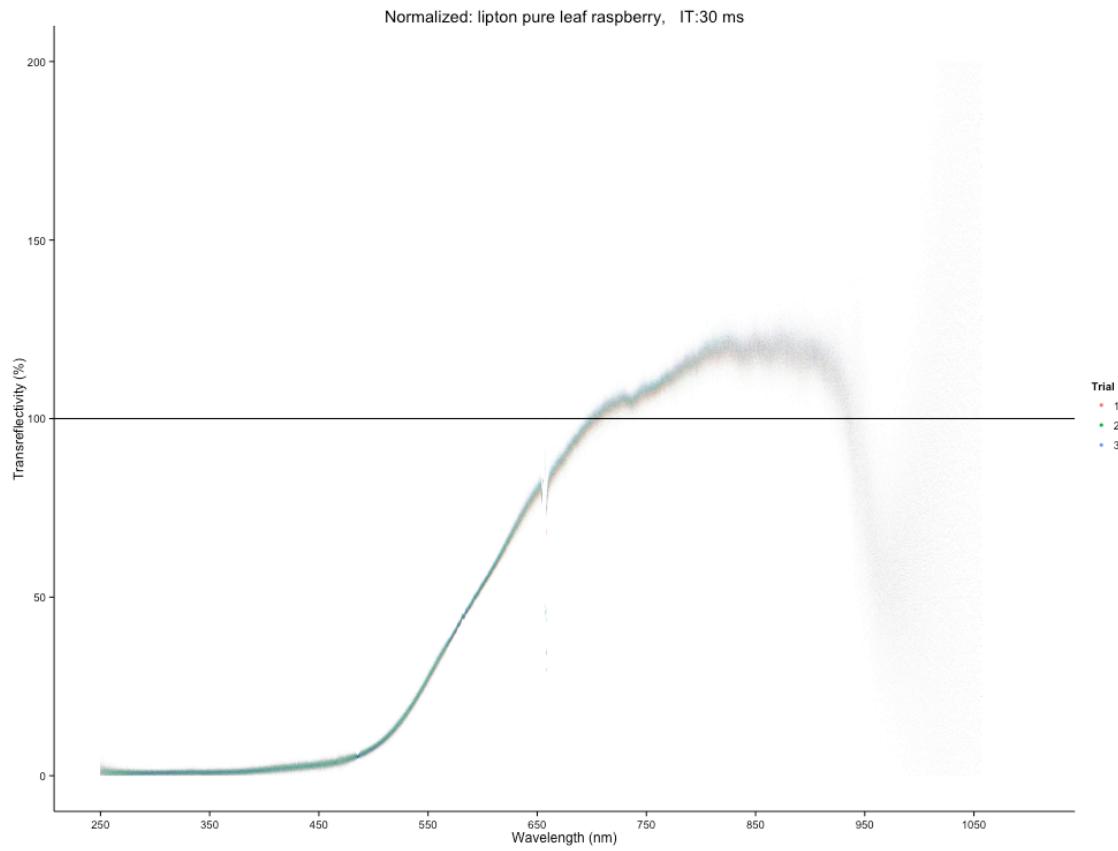
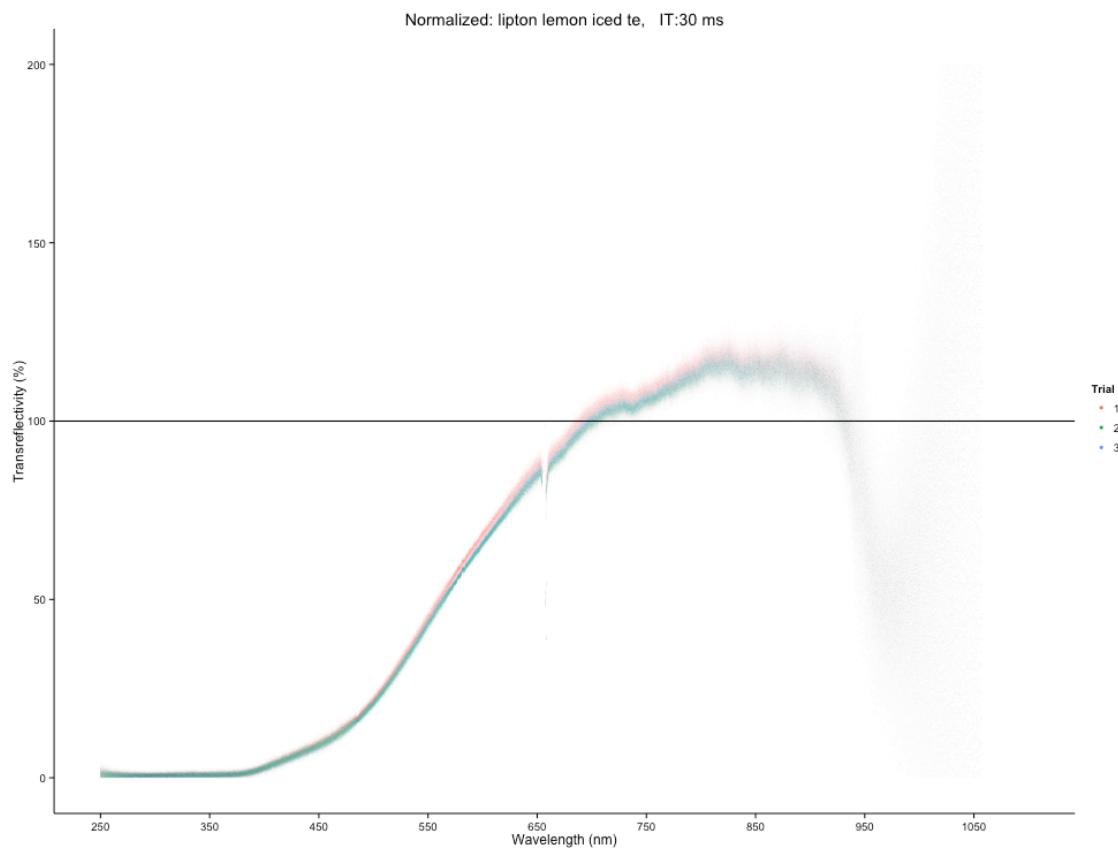


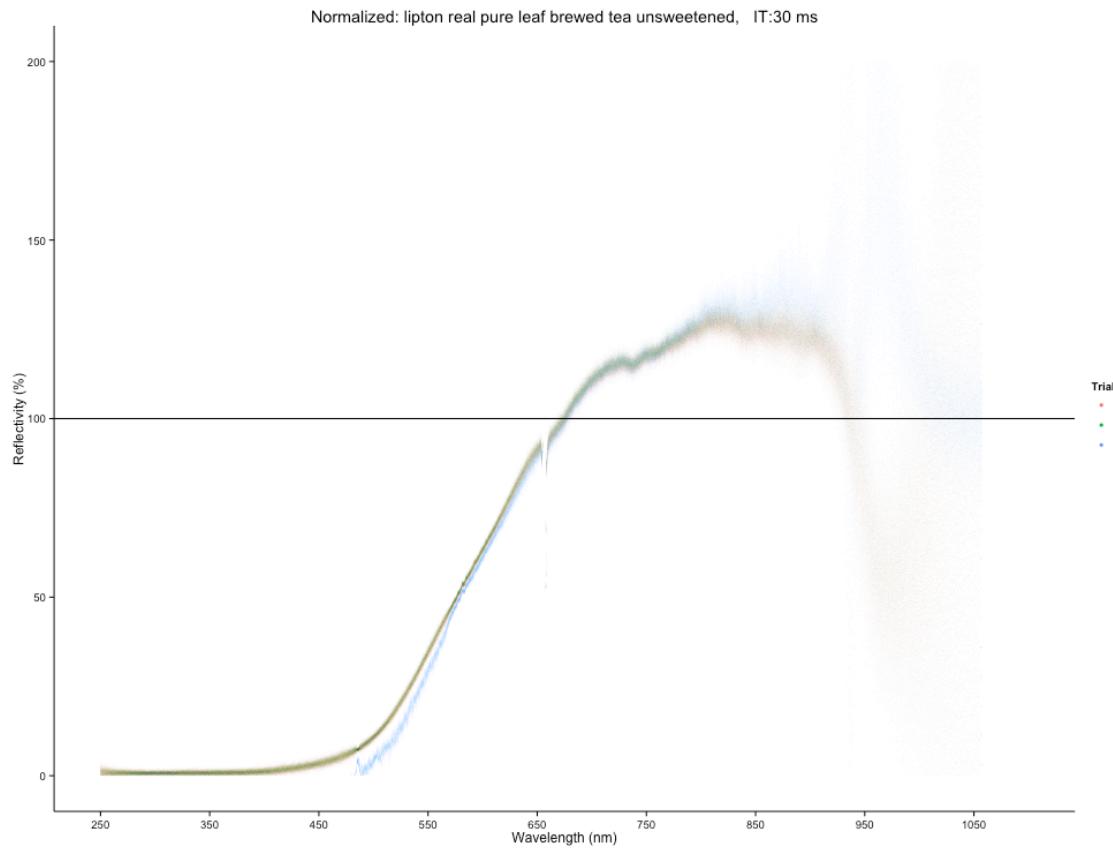
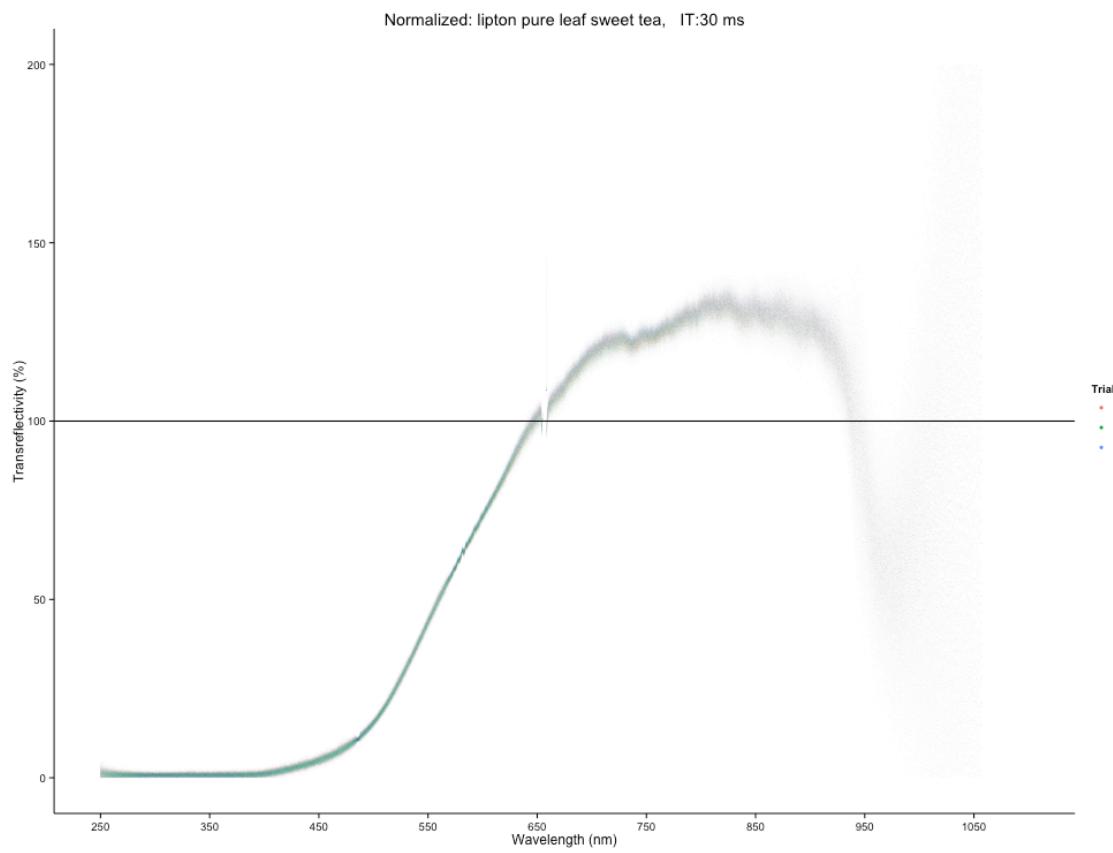


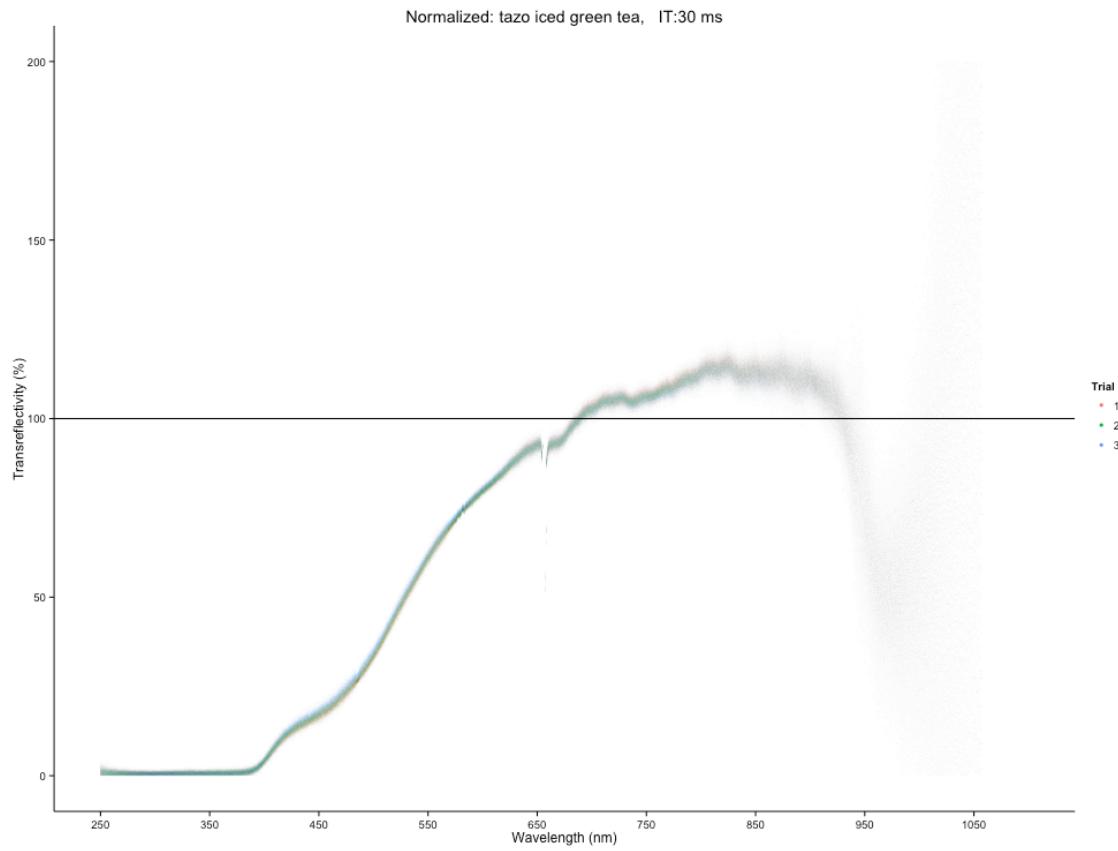
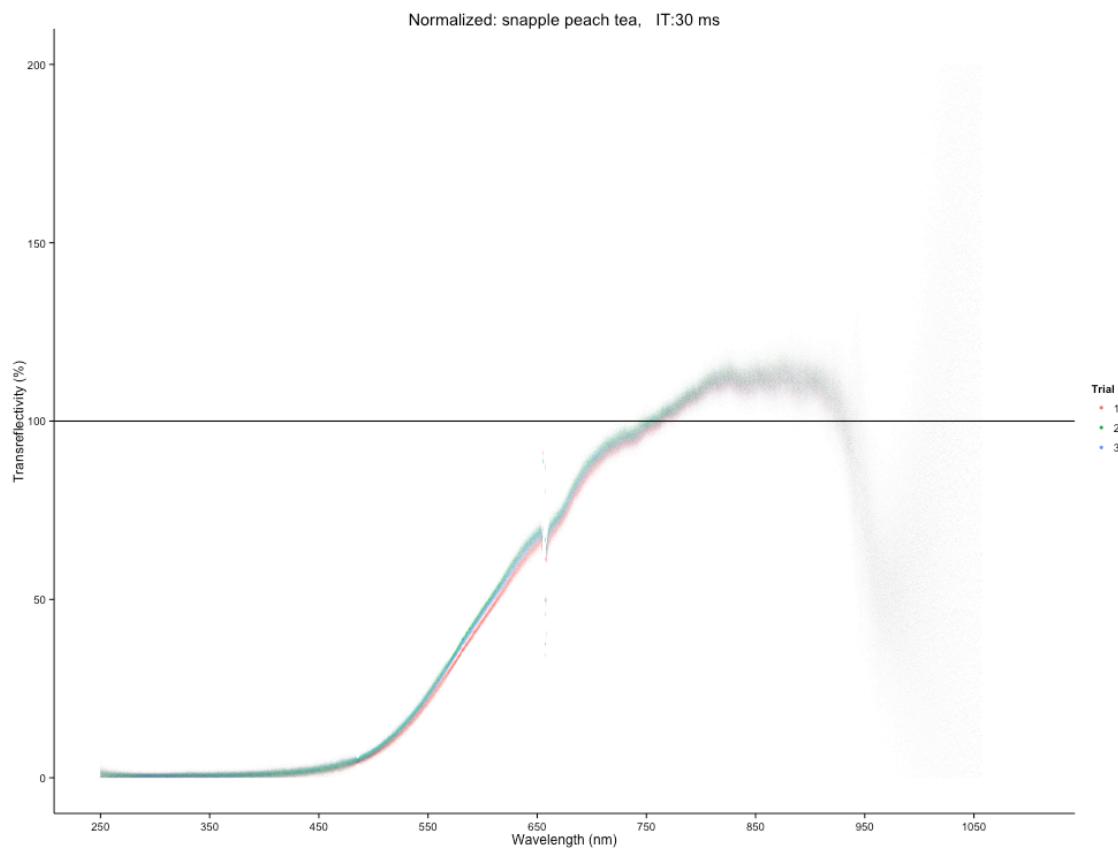
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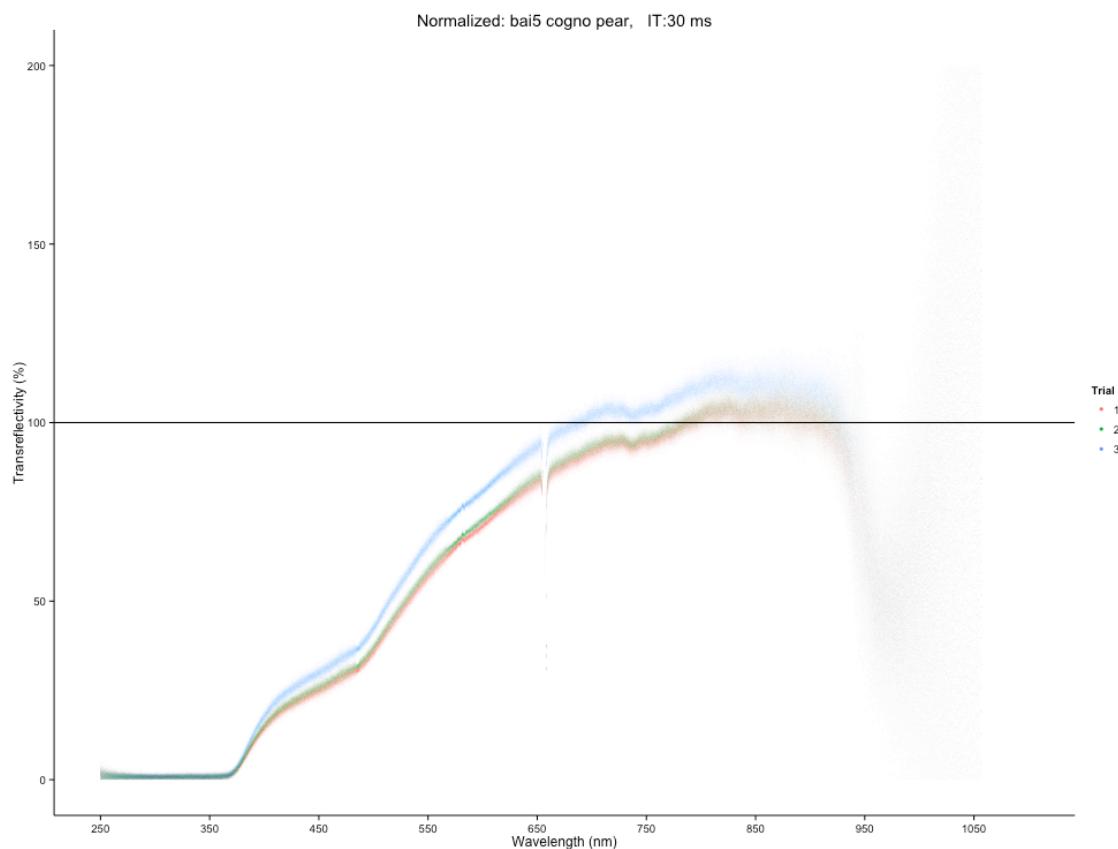
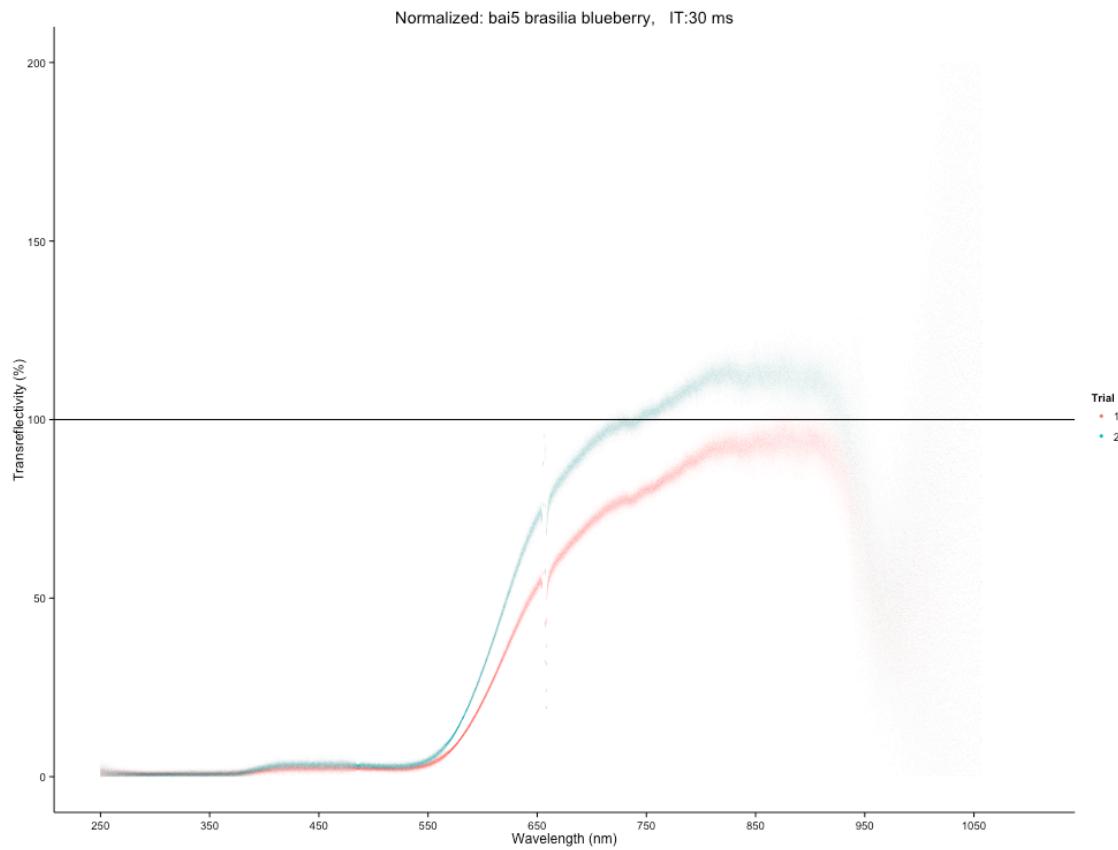


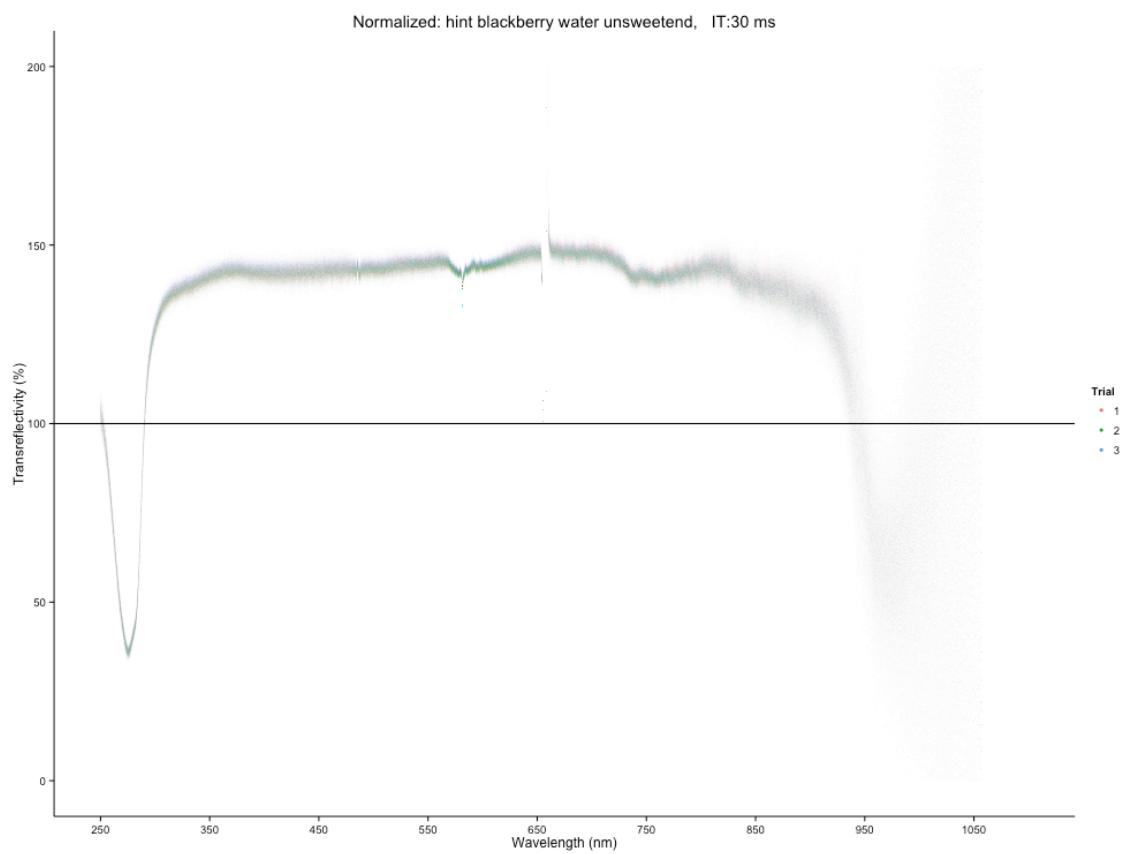
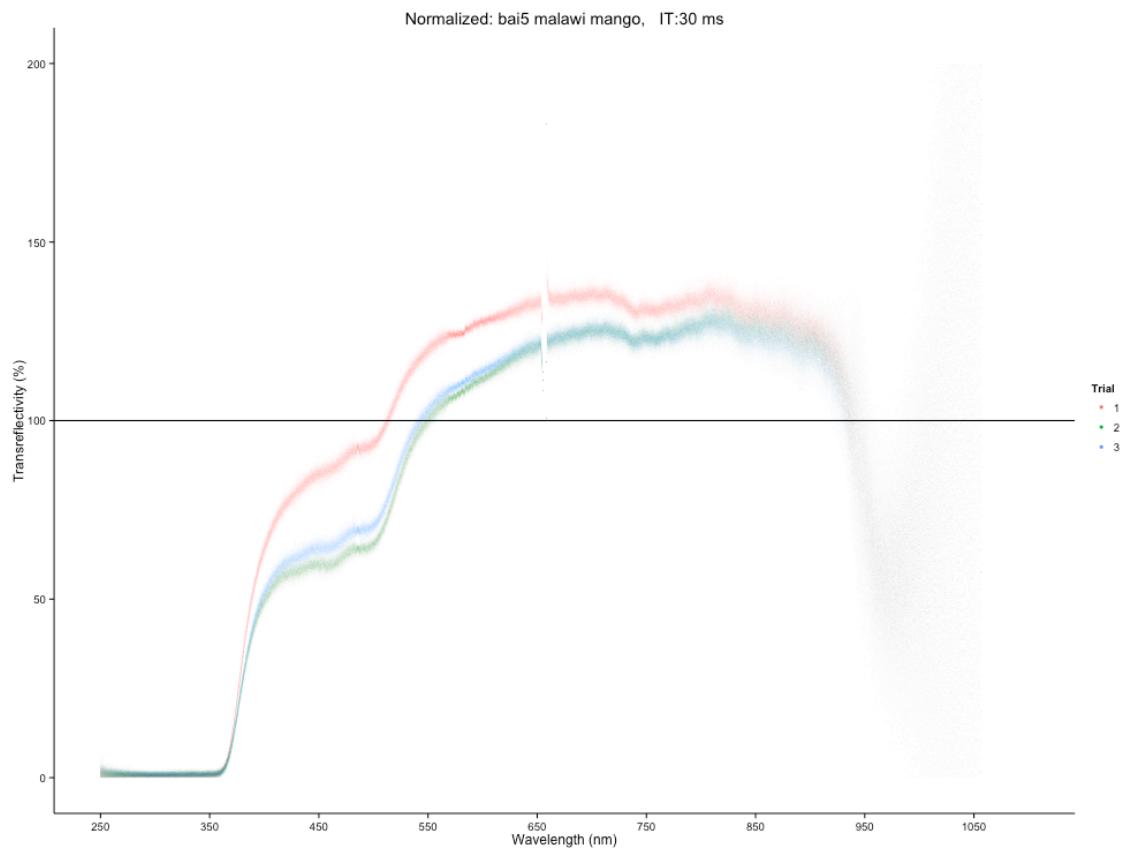


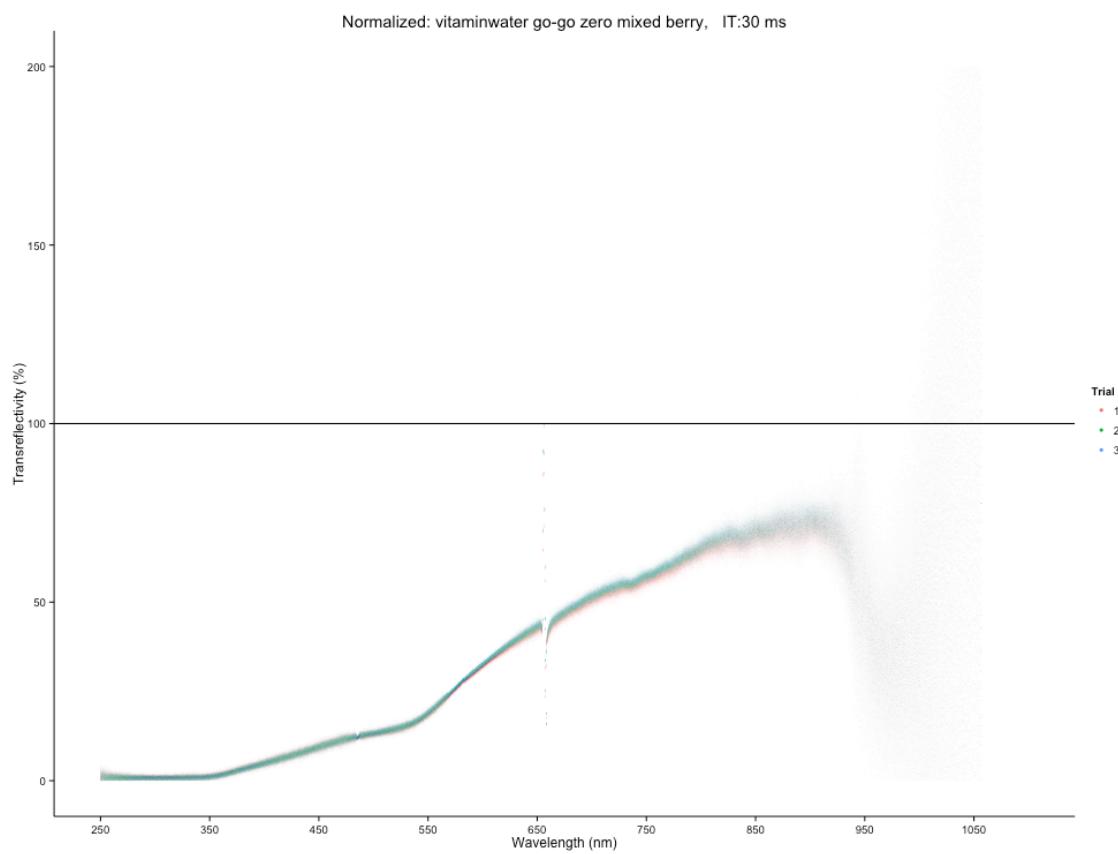
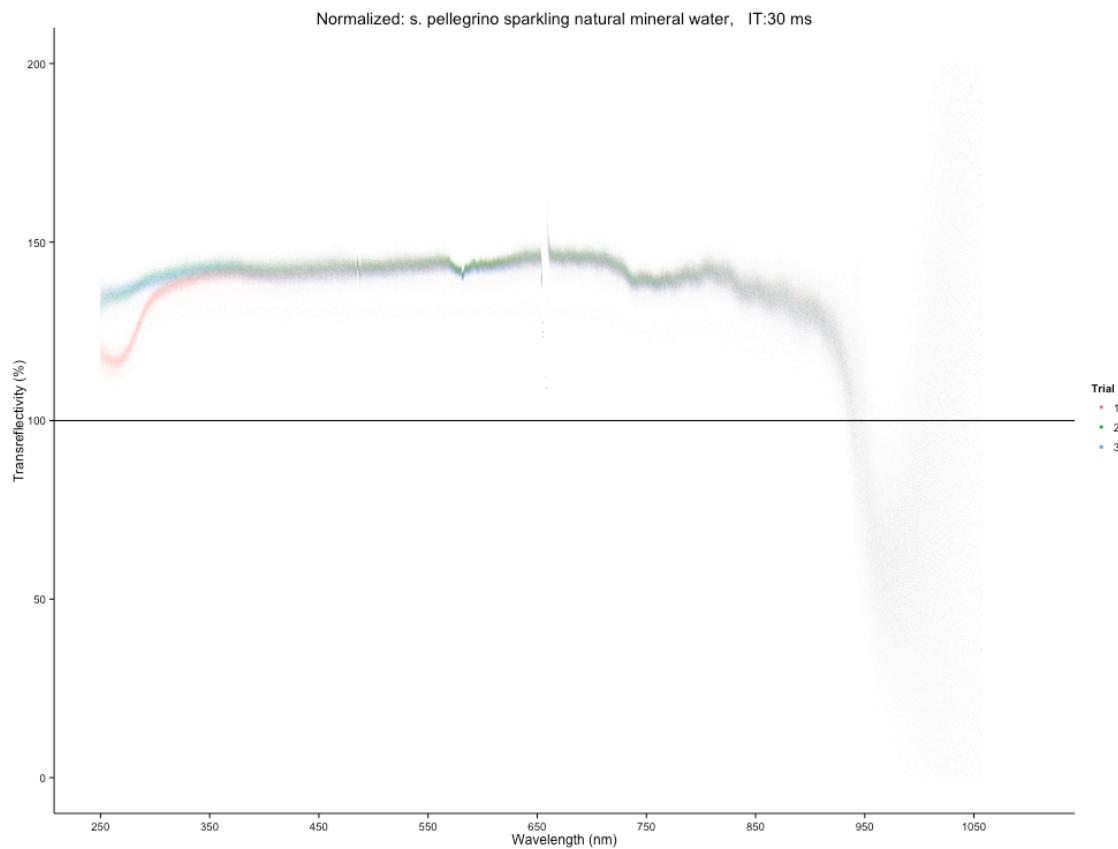


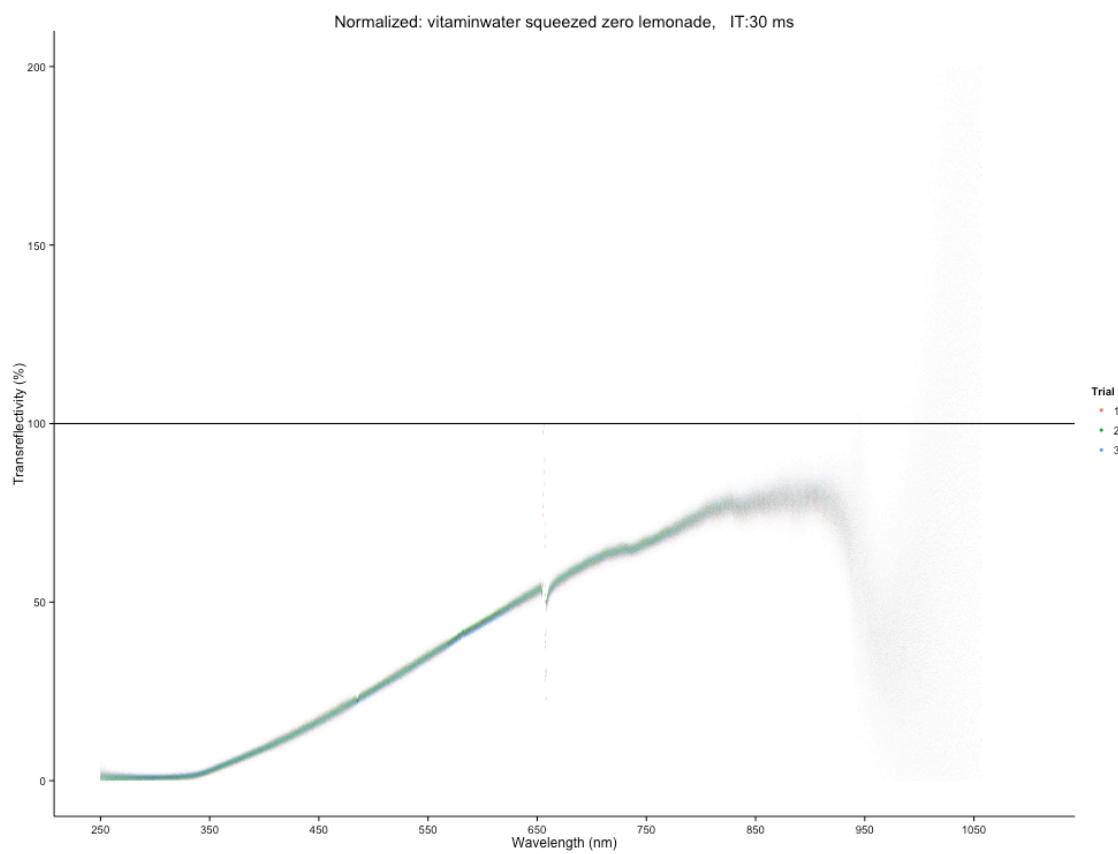
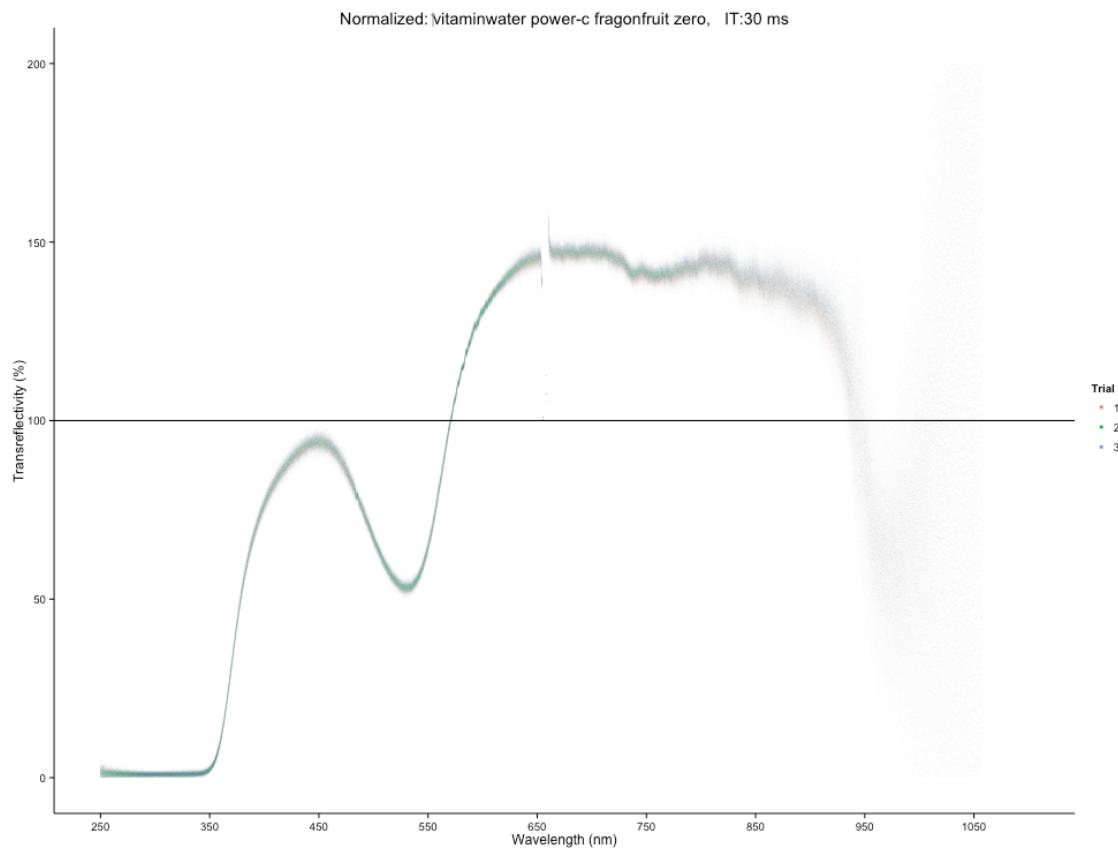


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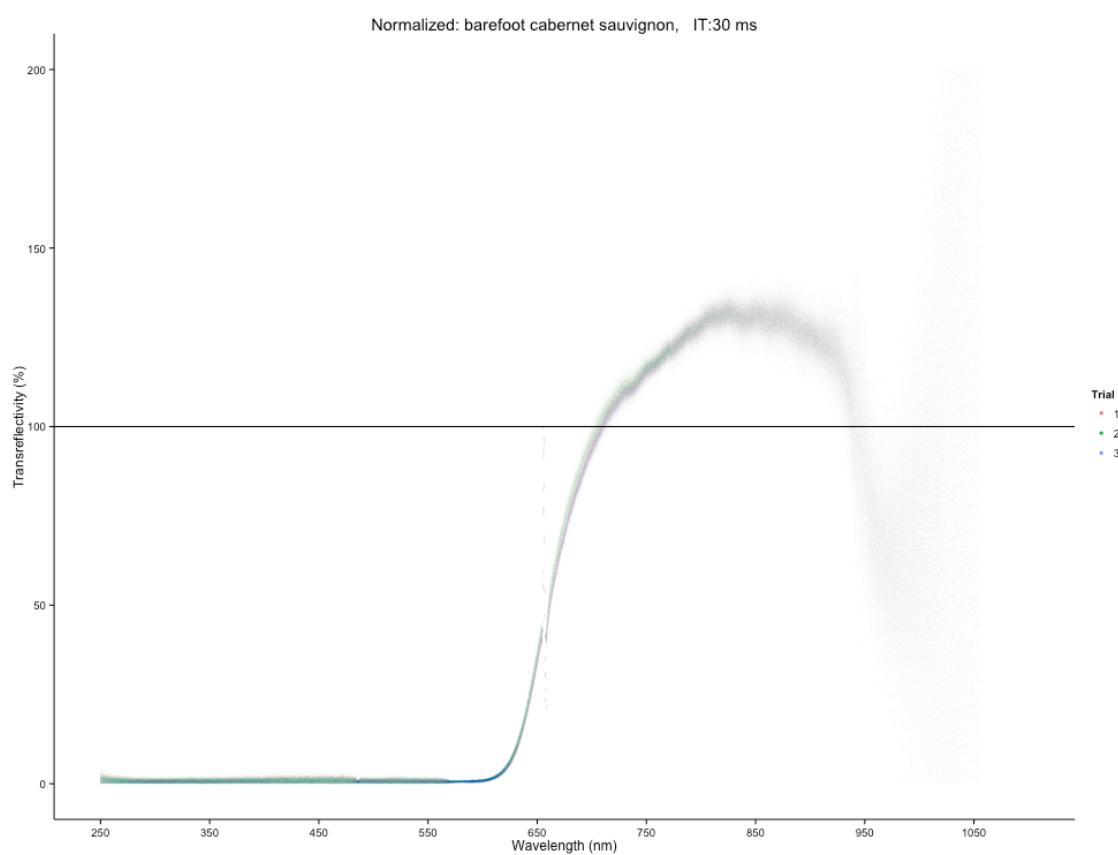
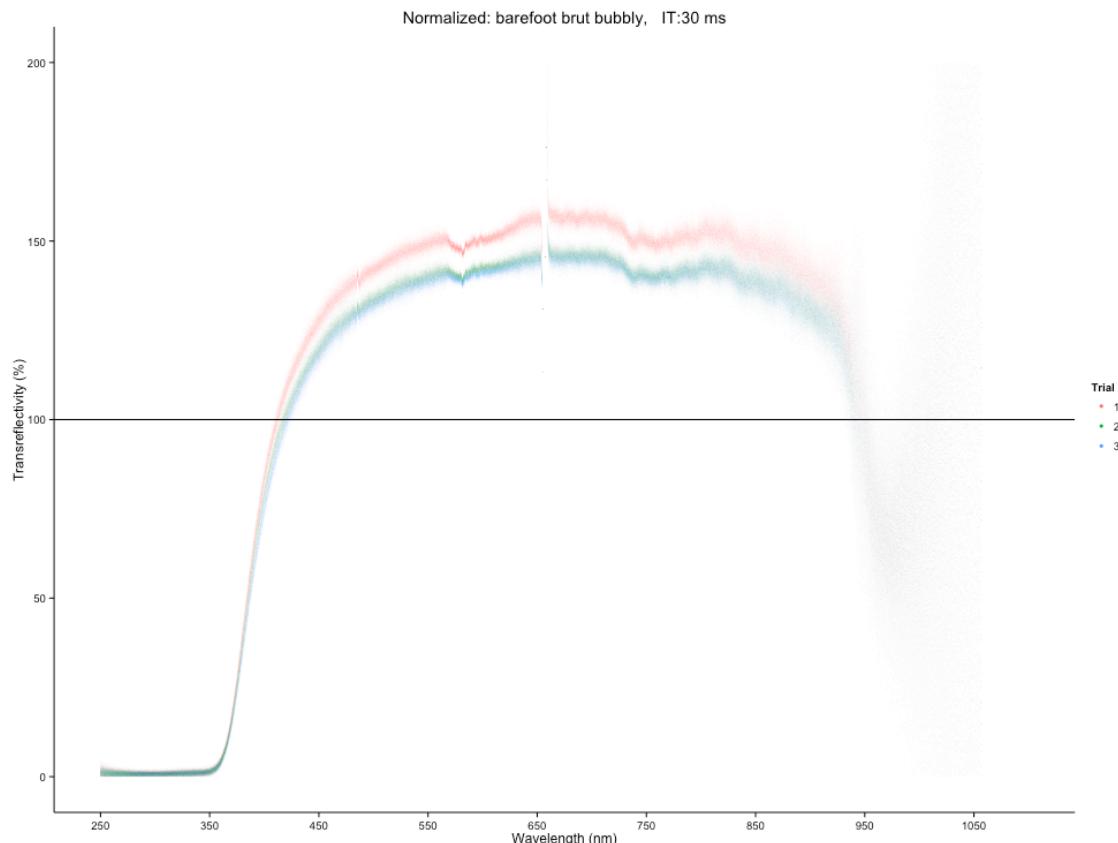


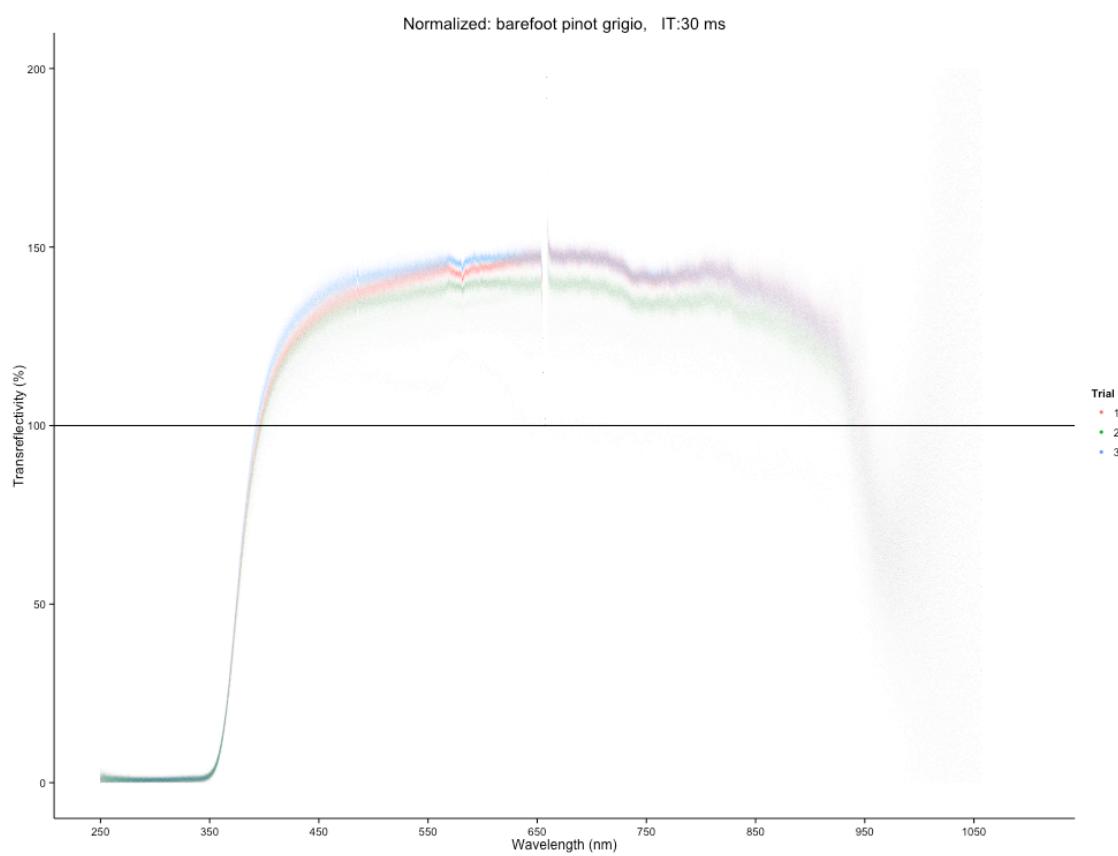
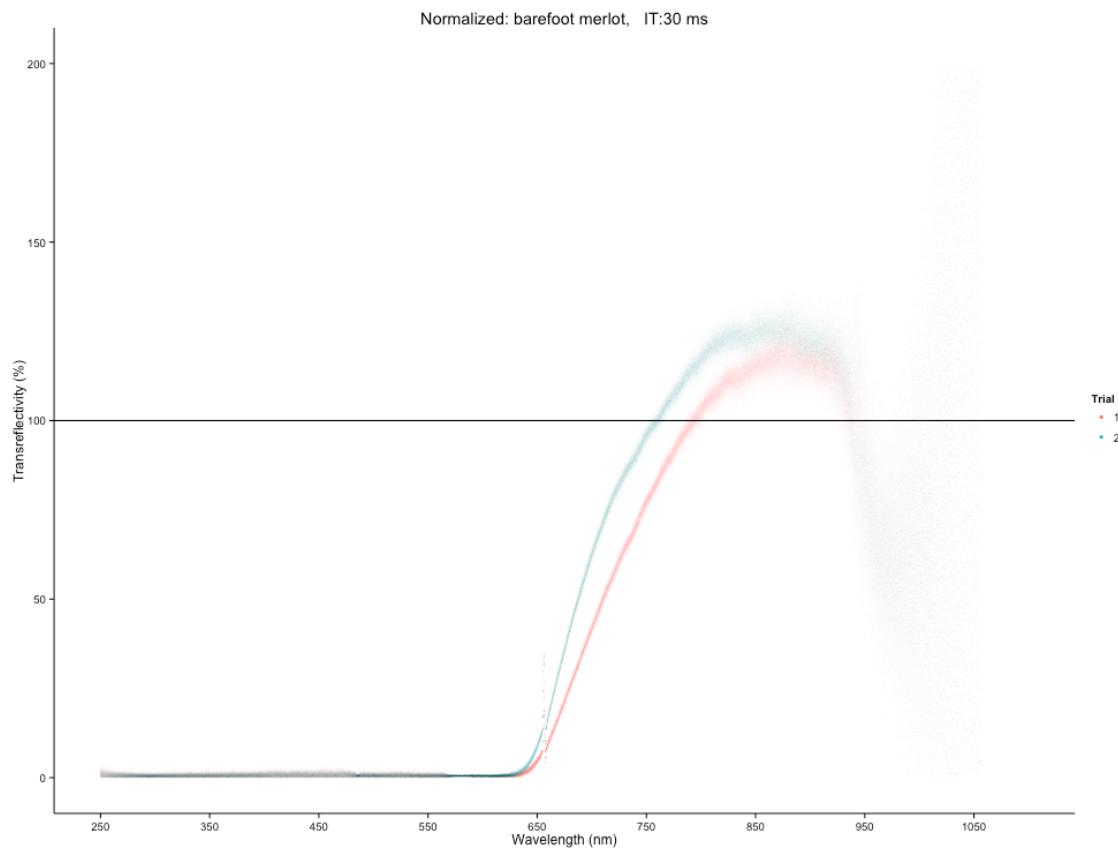


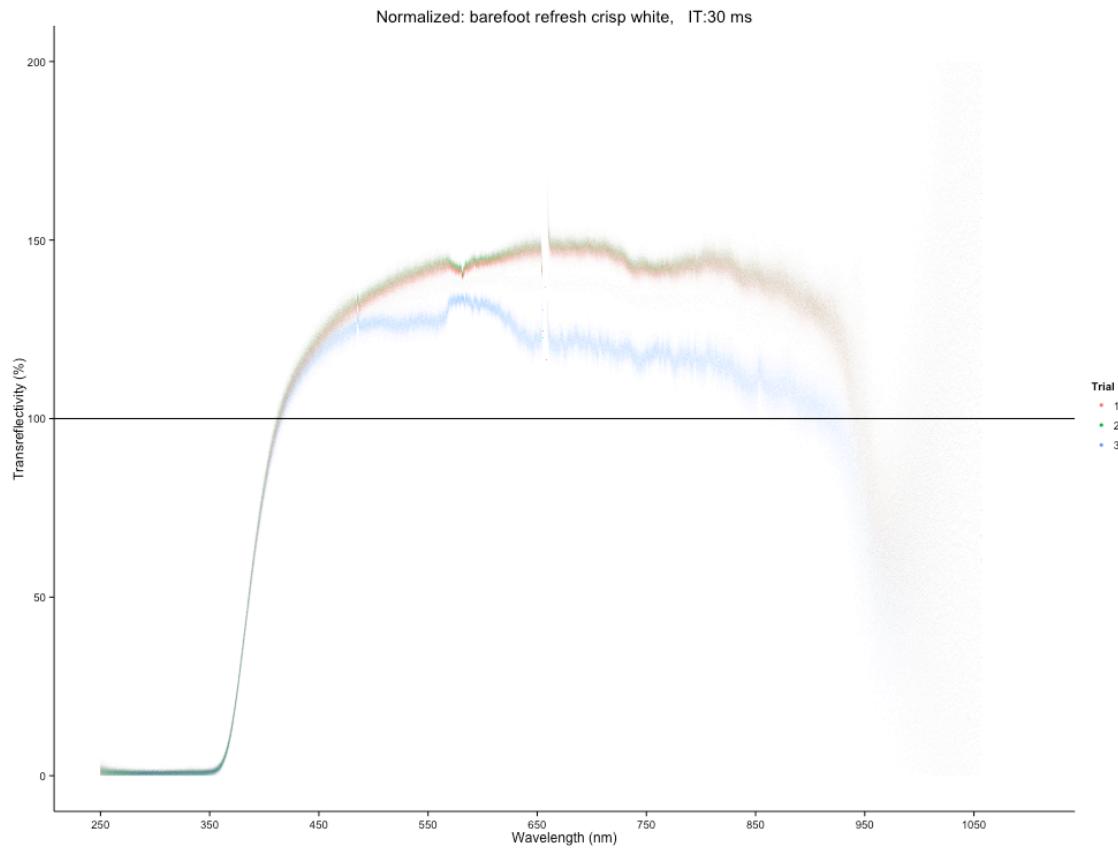
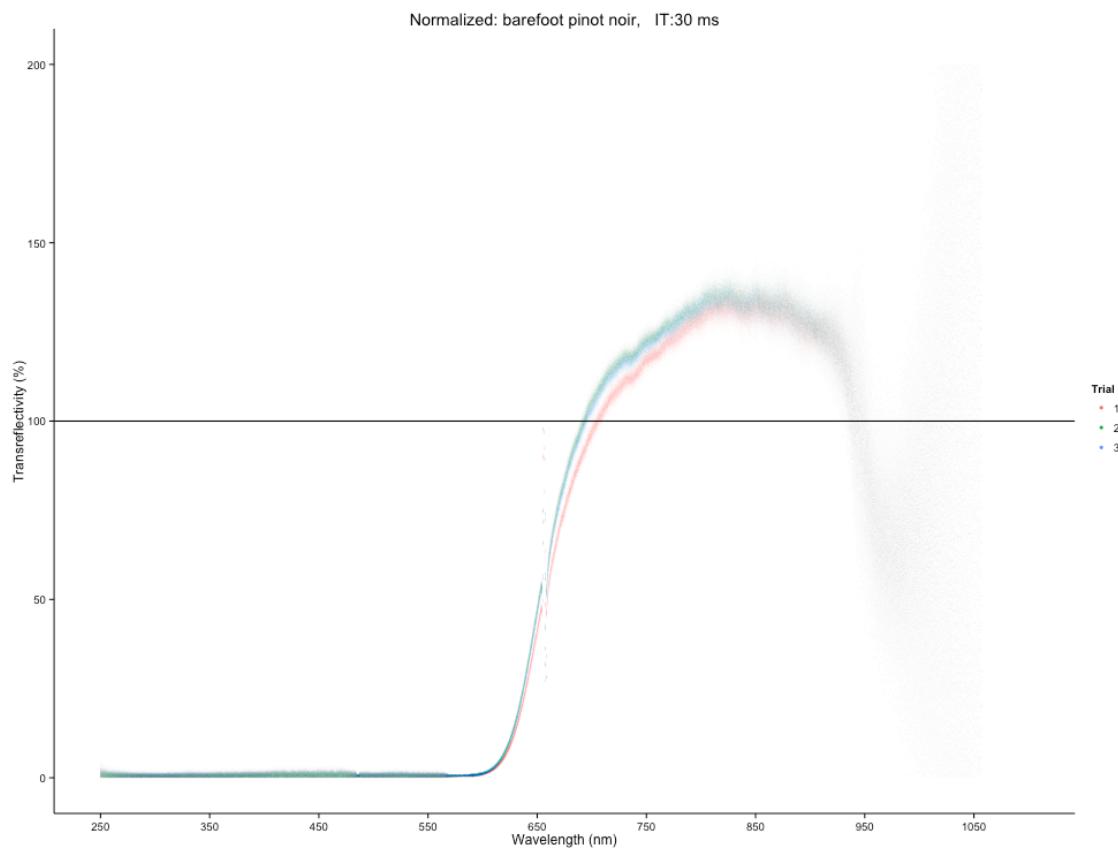


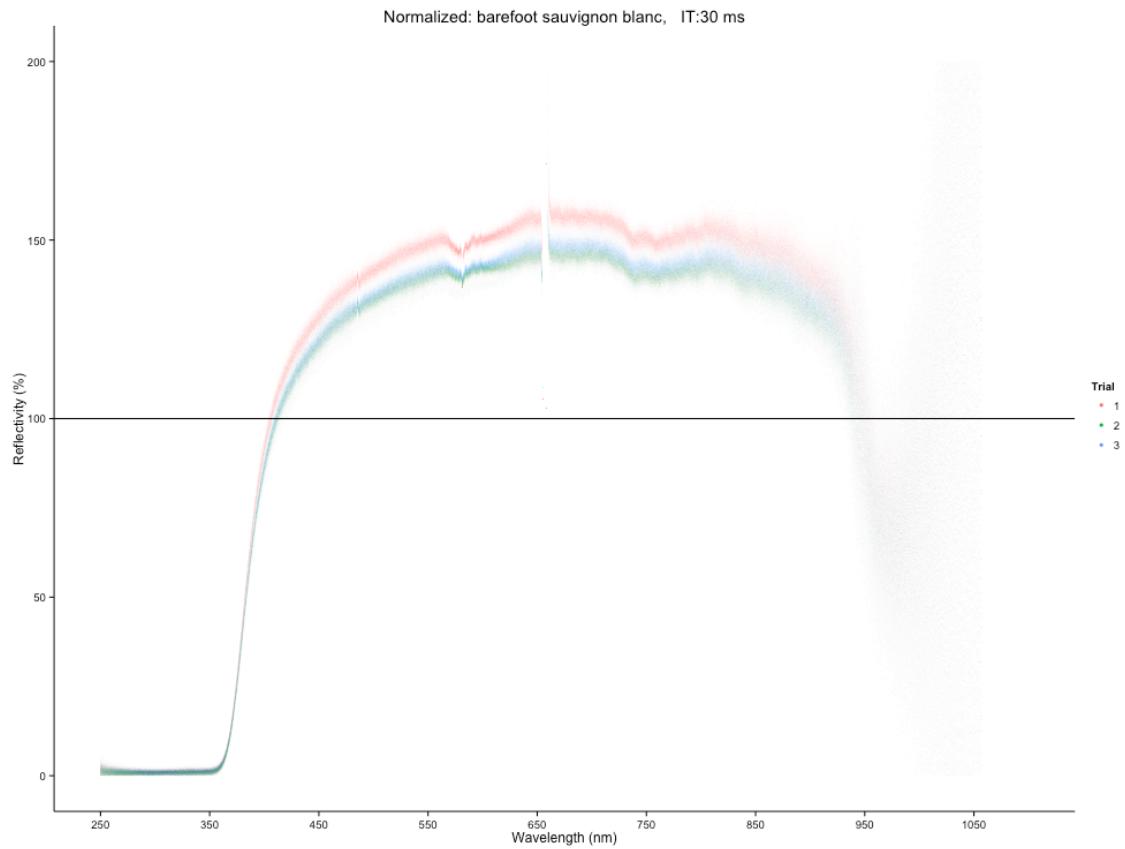
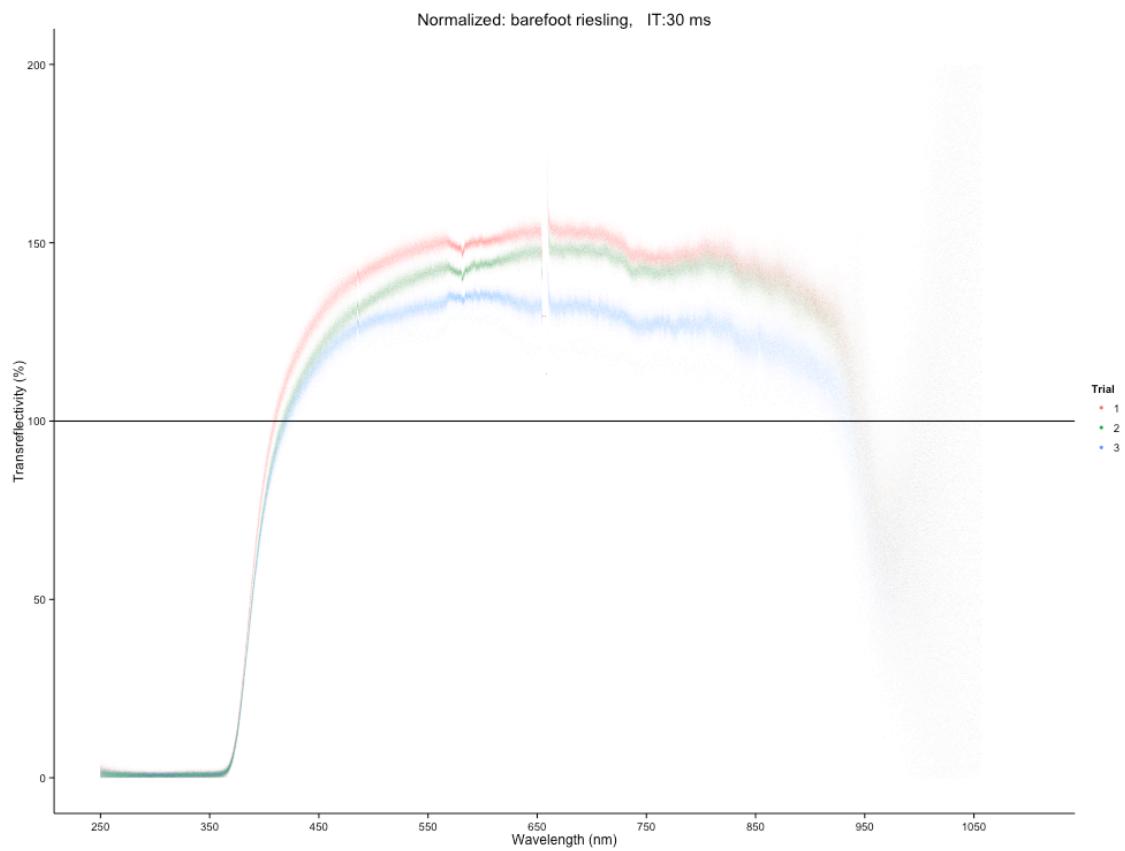


Wine



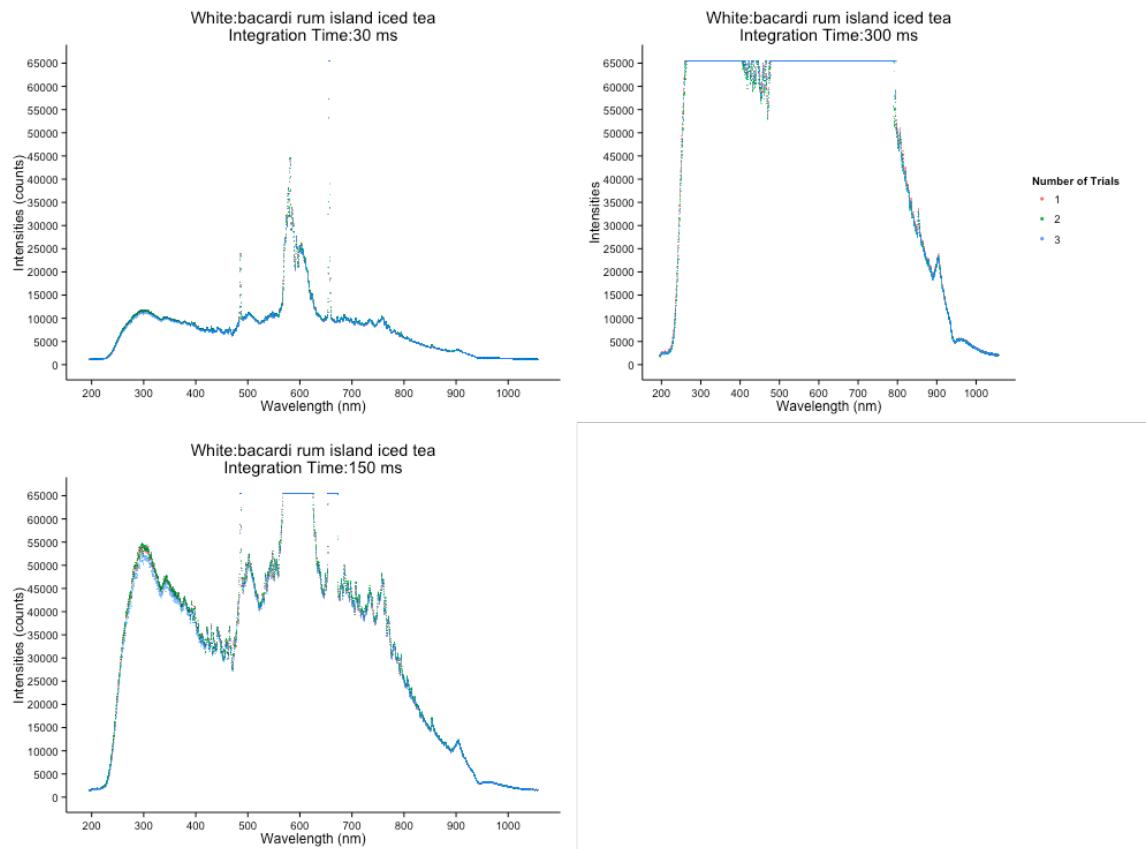


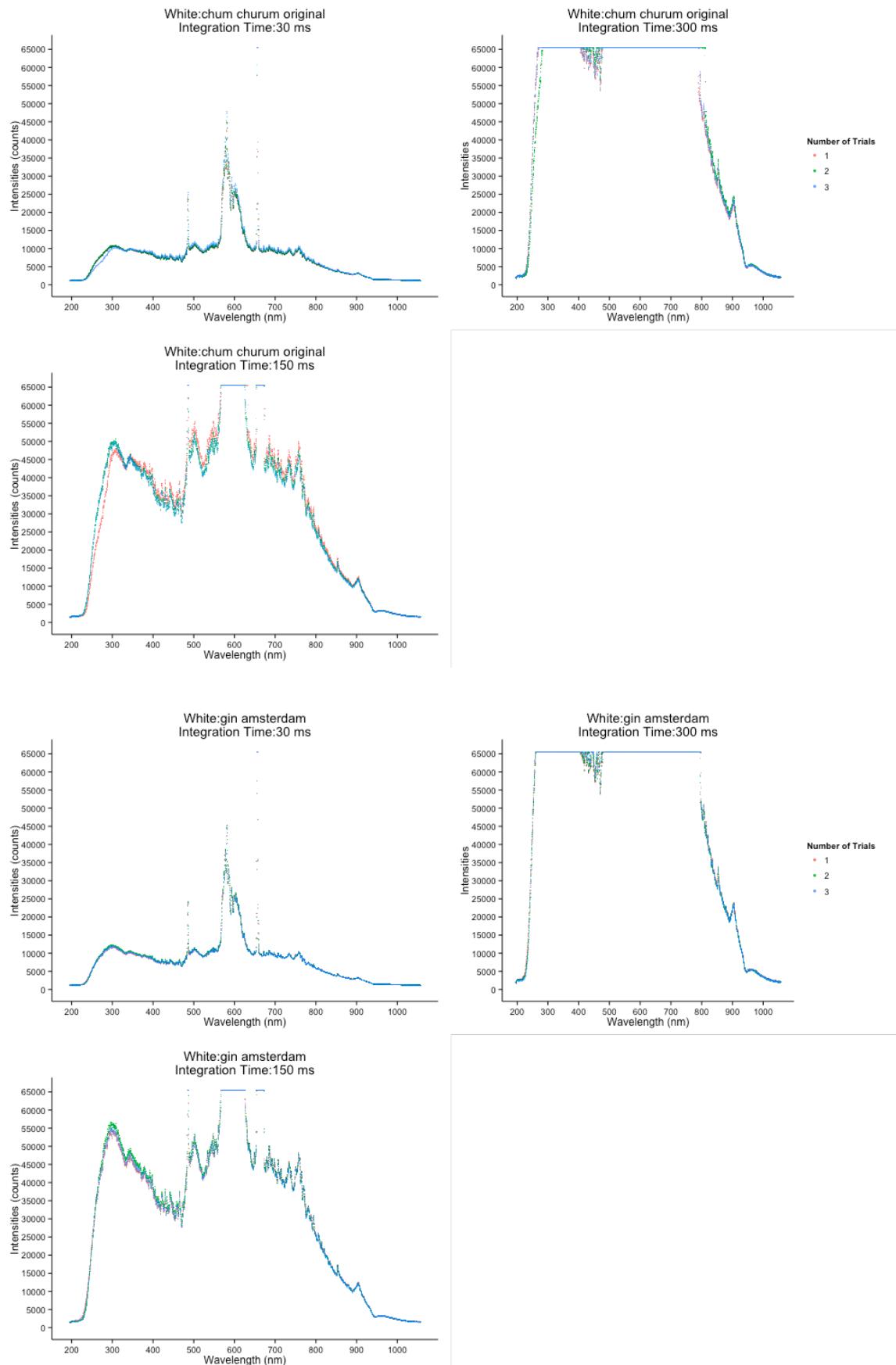


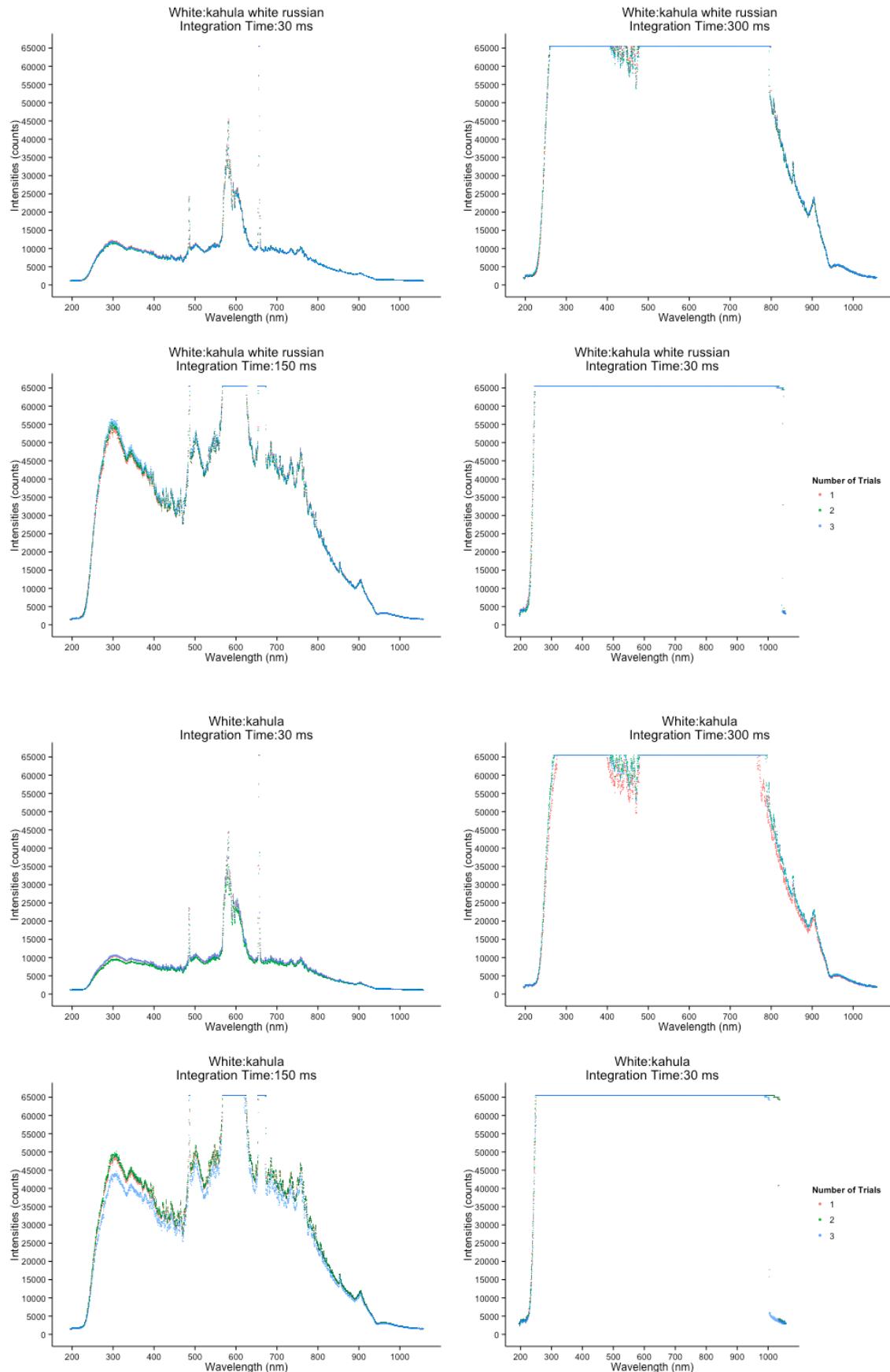


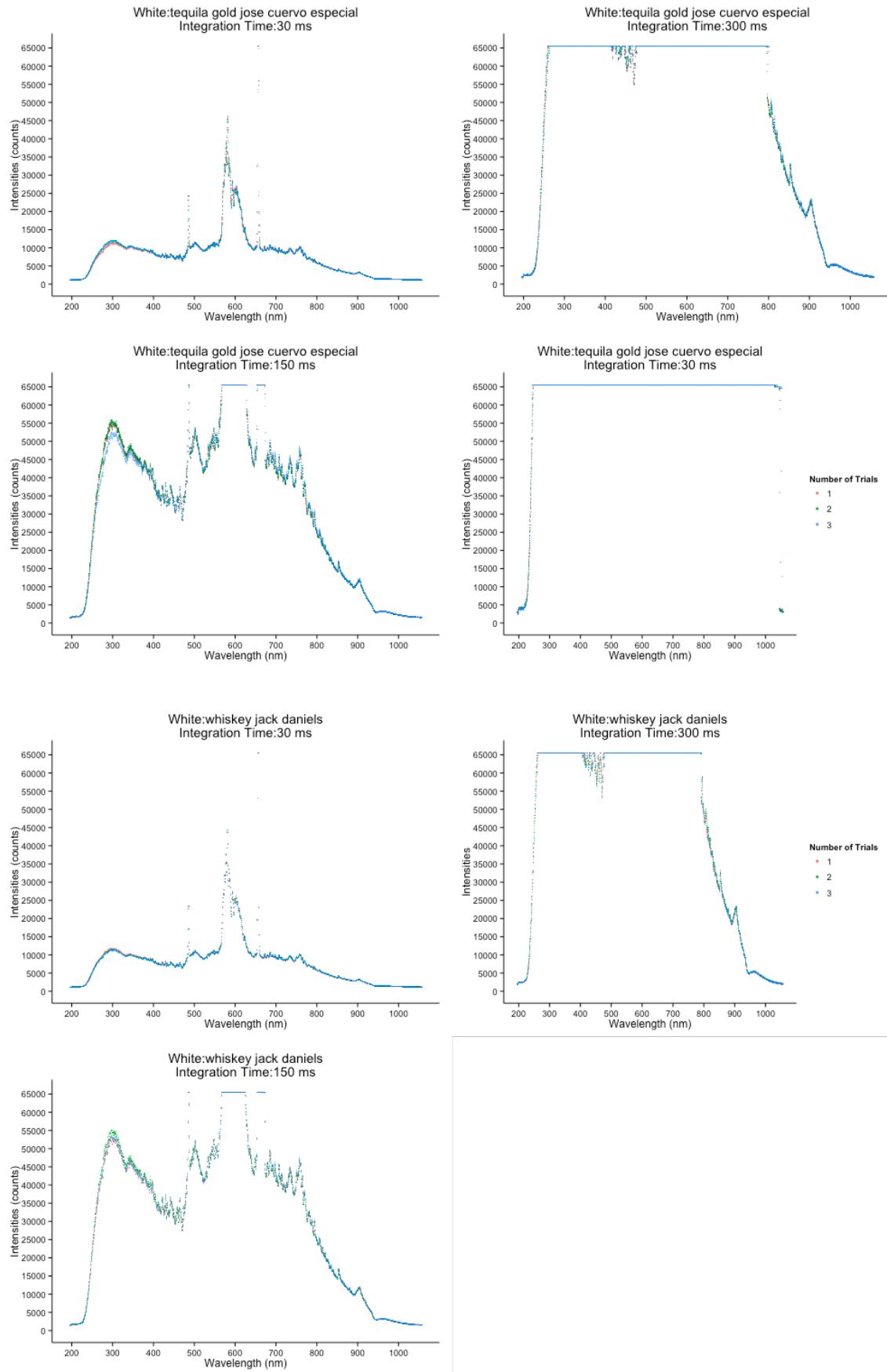
Appendix C-White

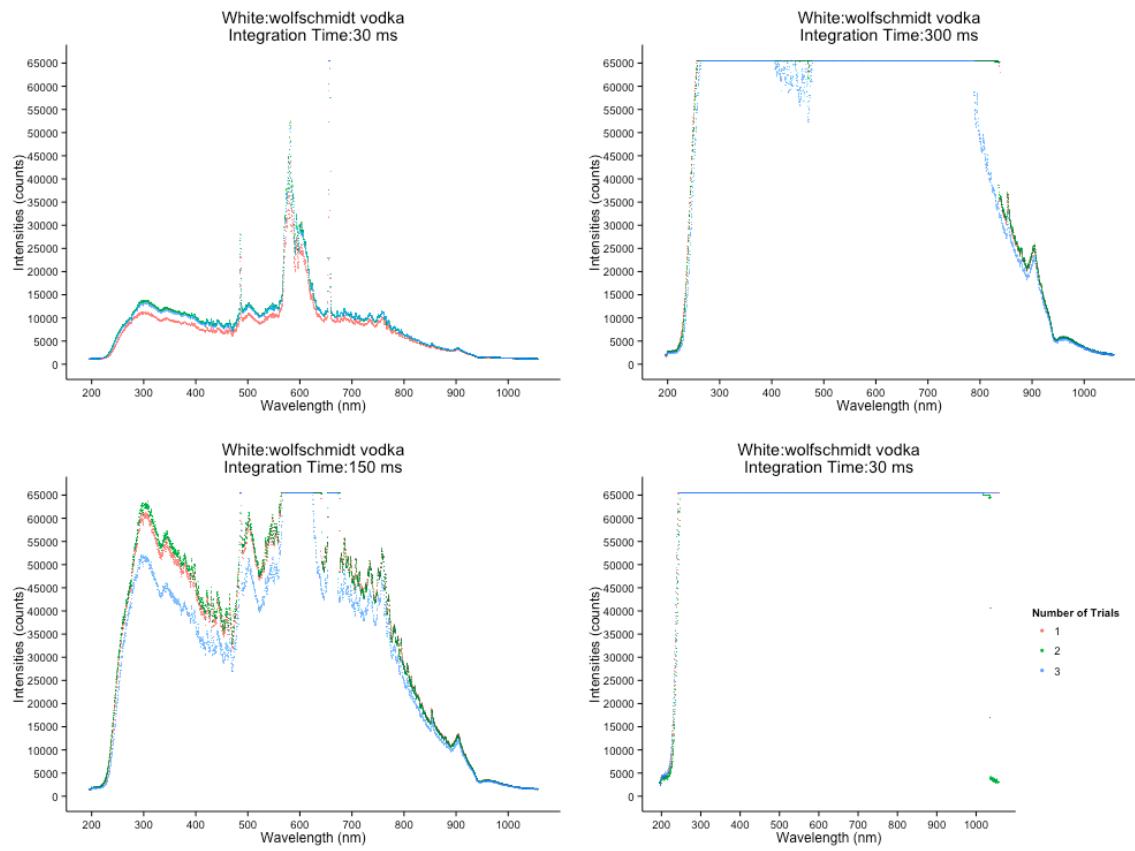
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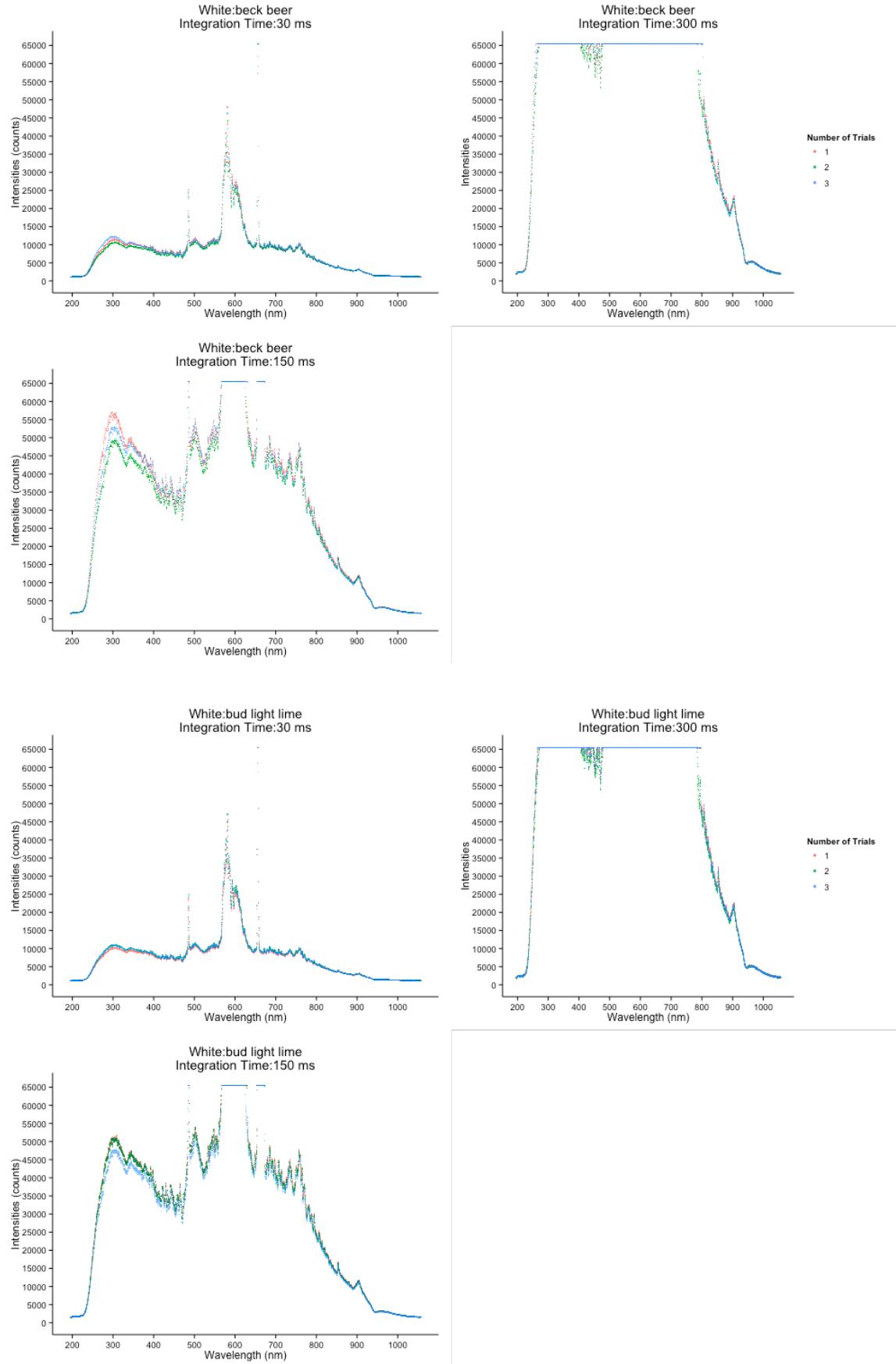


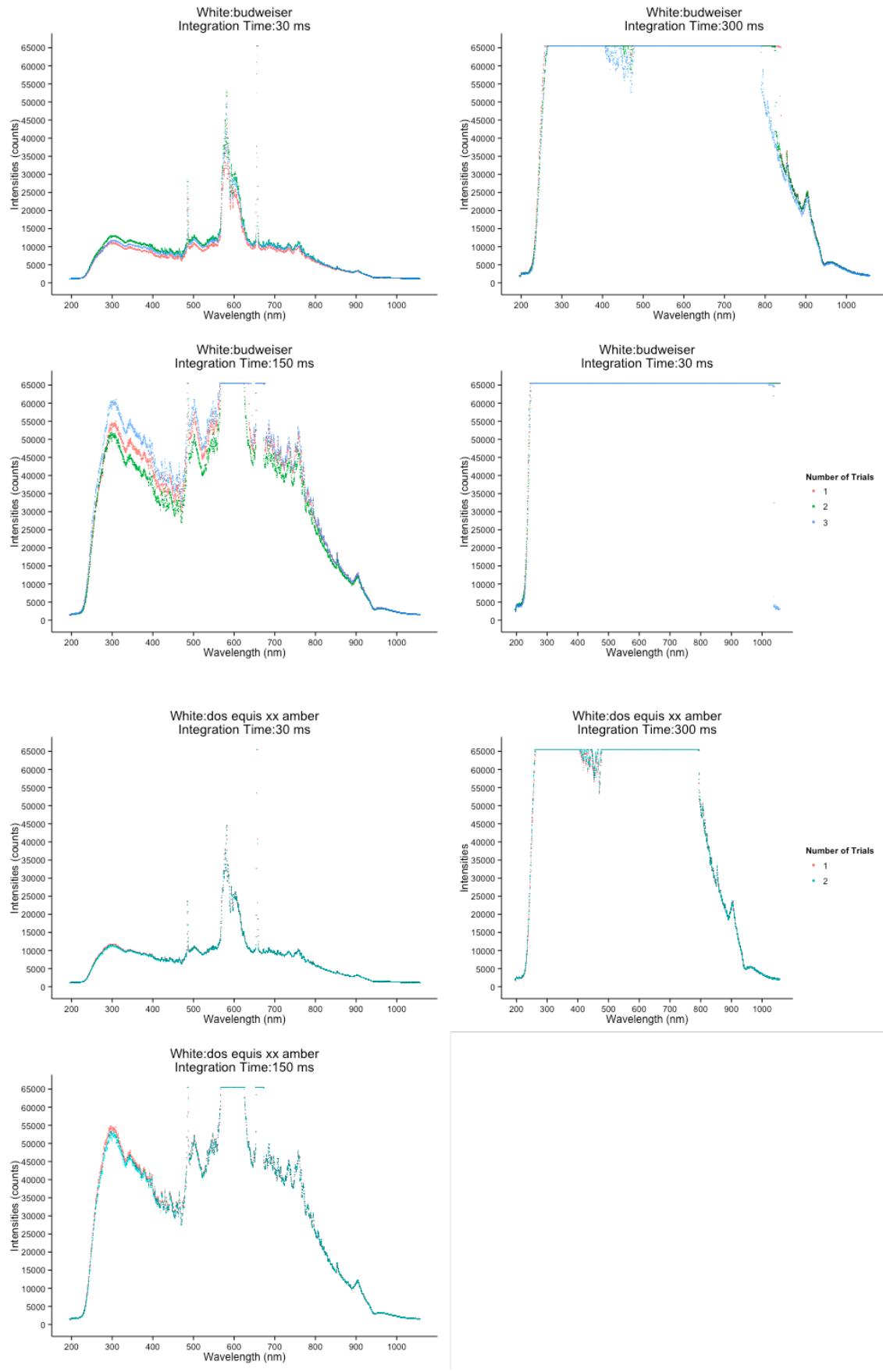


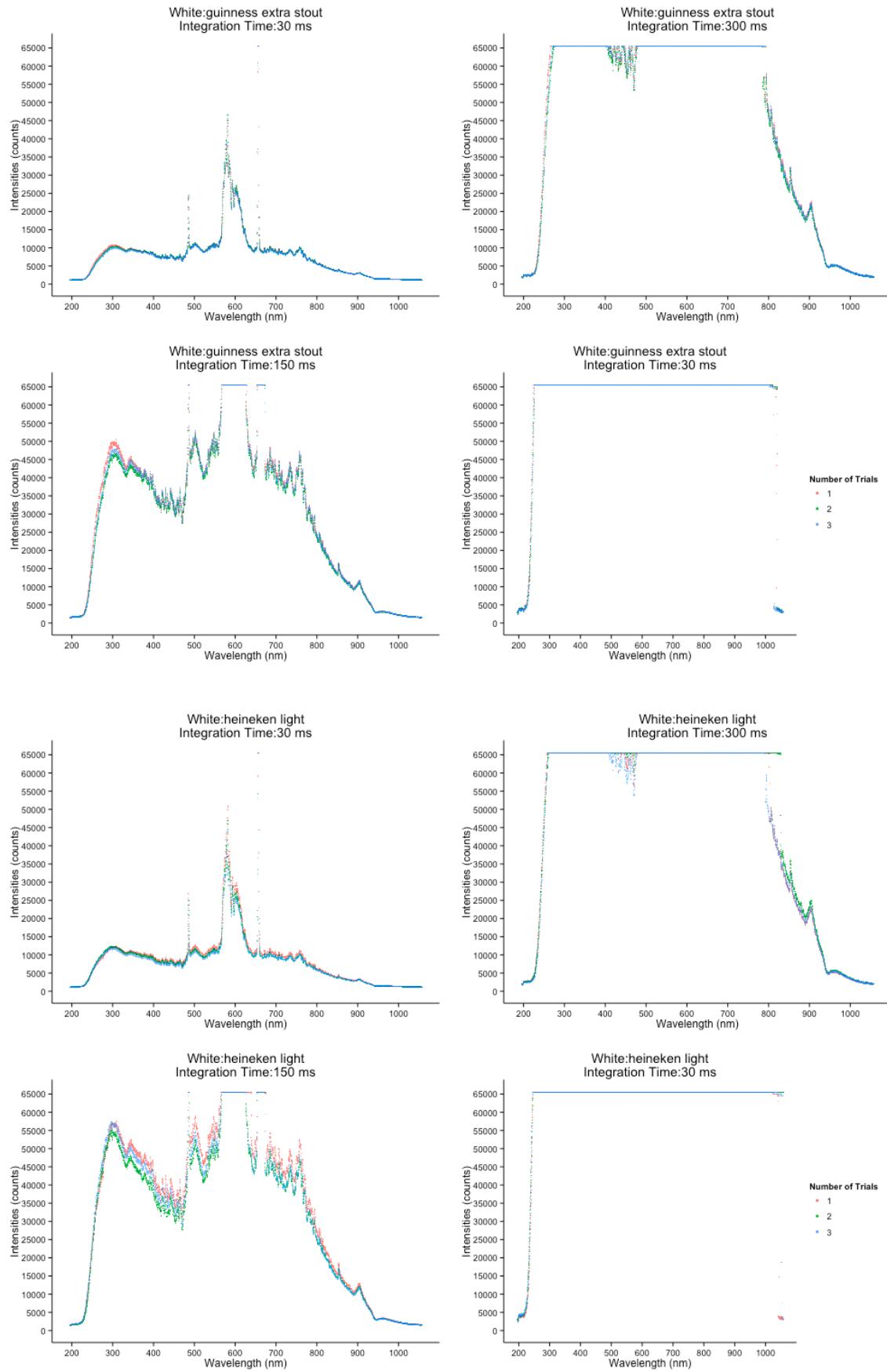


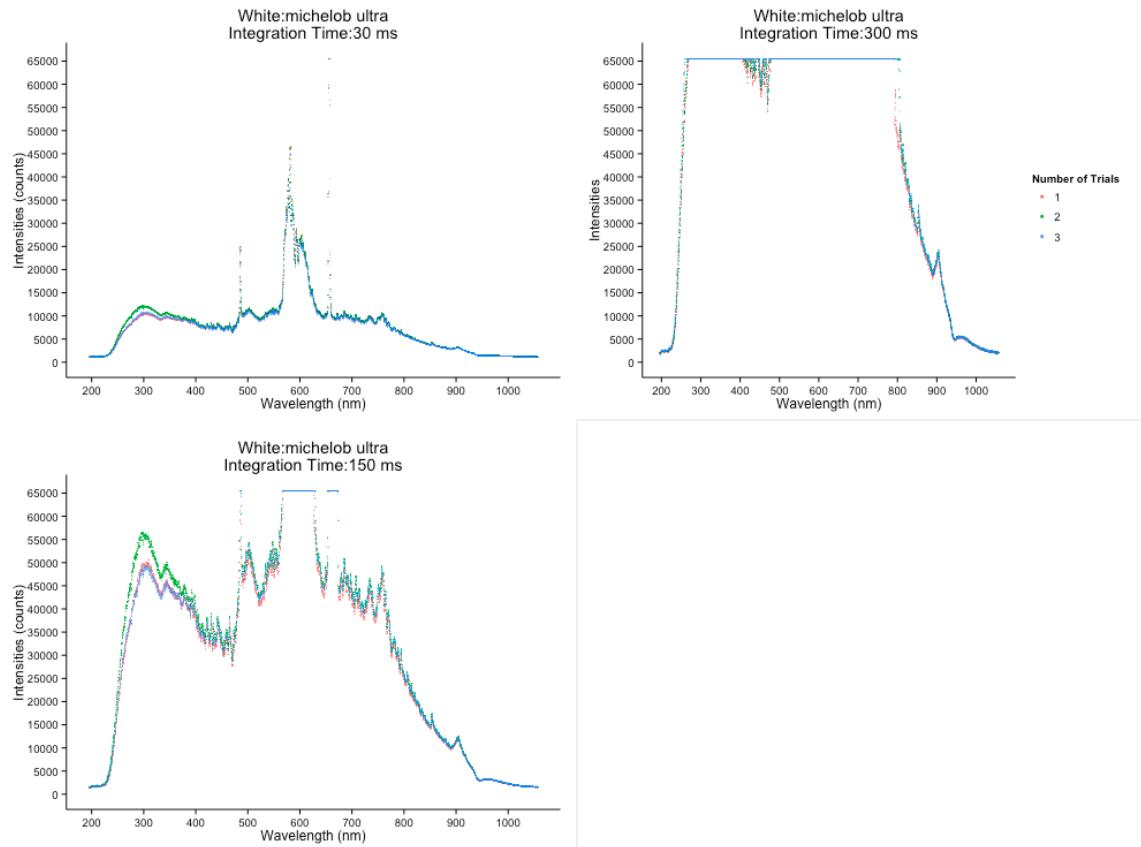


Beer:

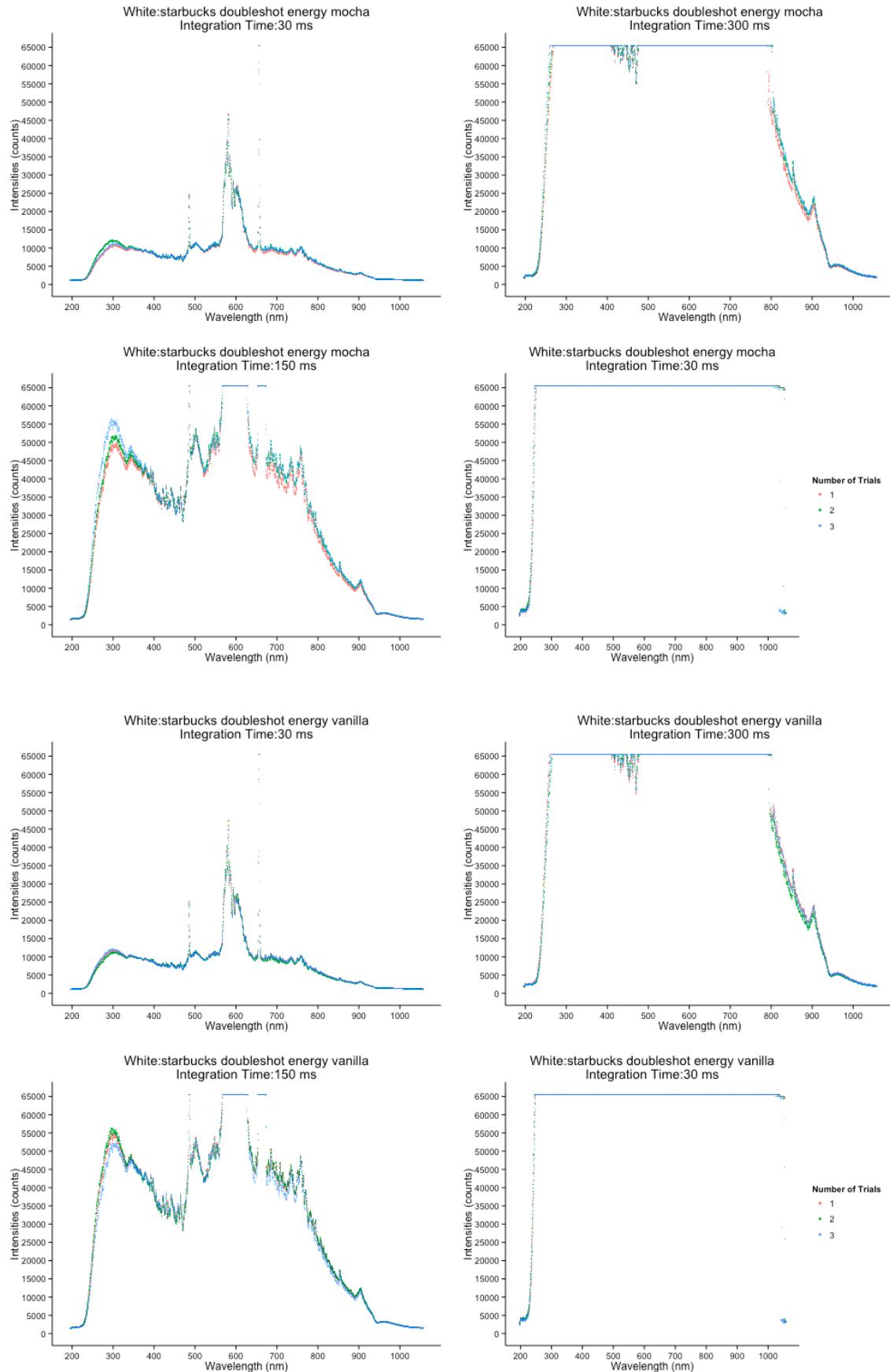


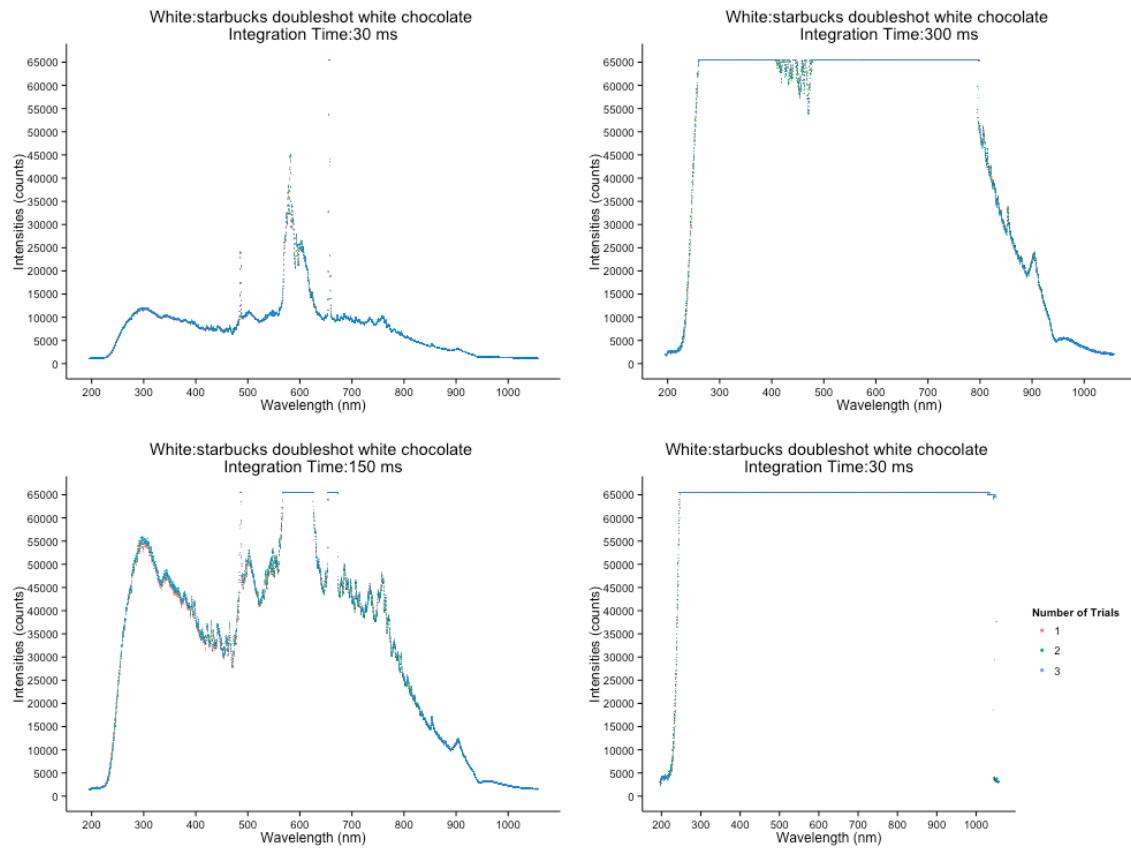


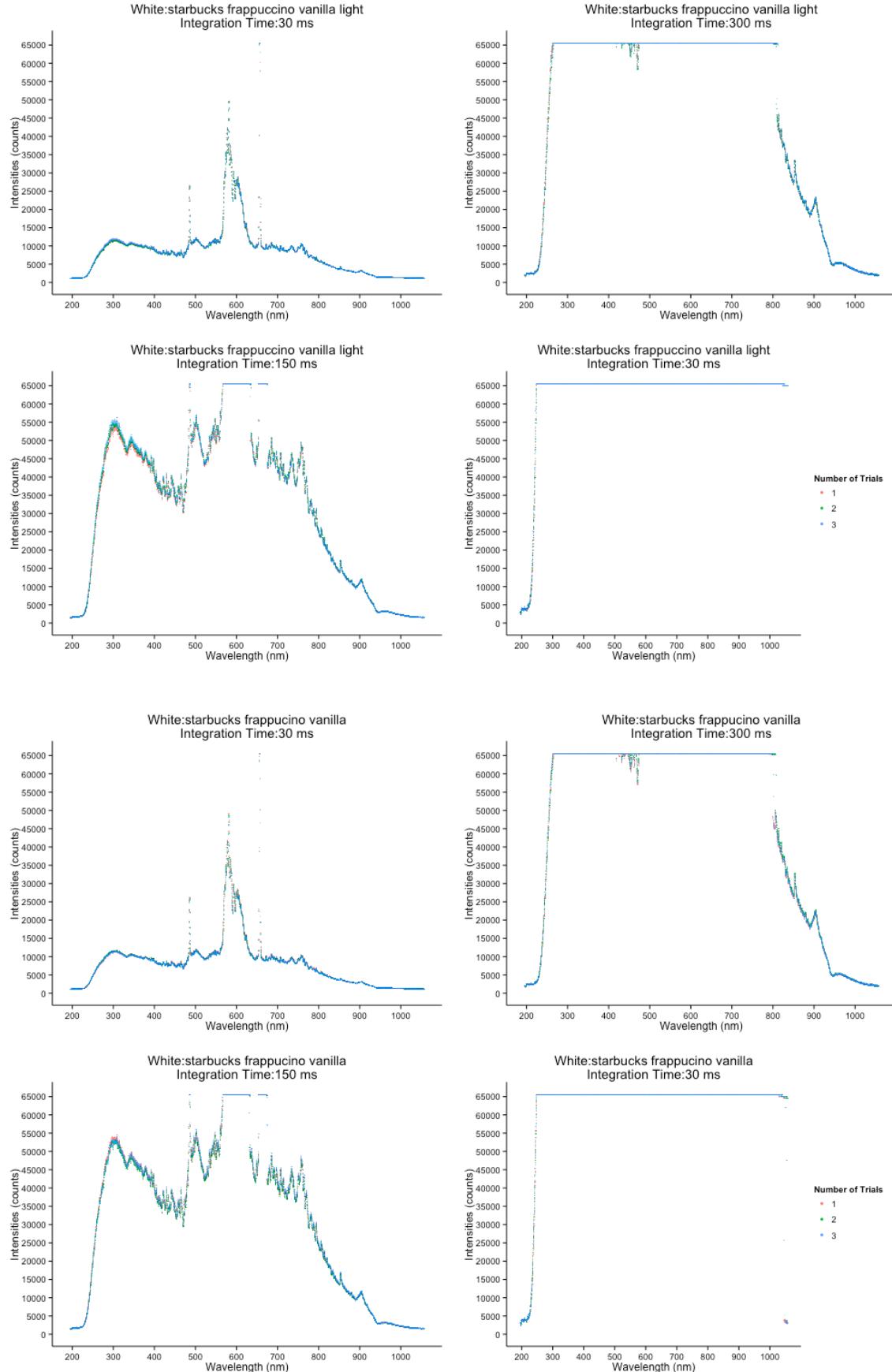


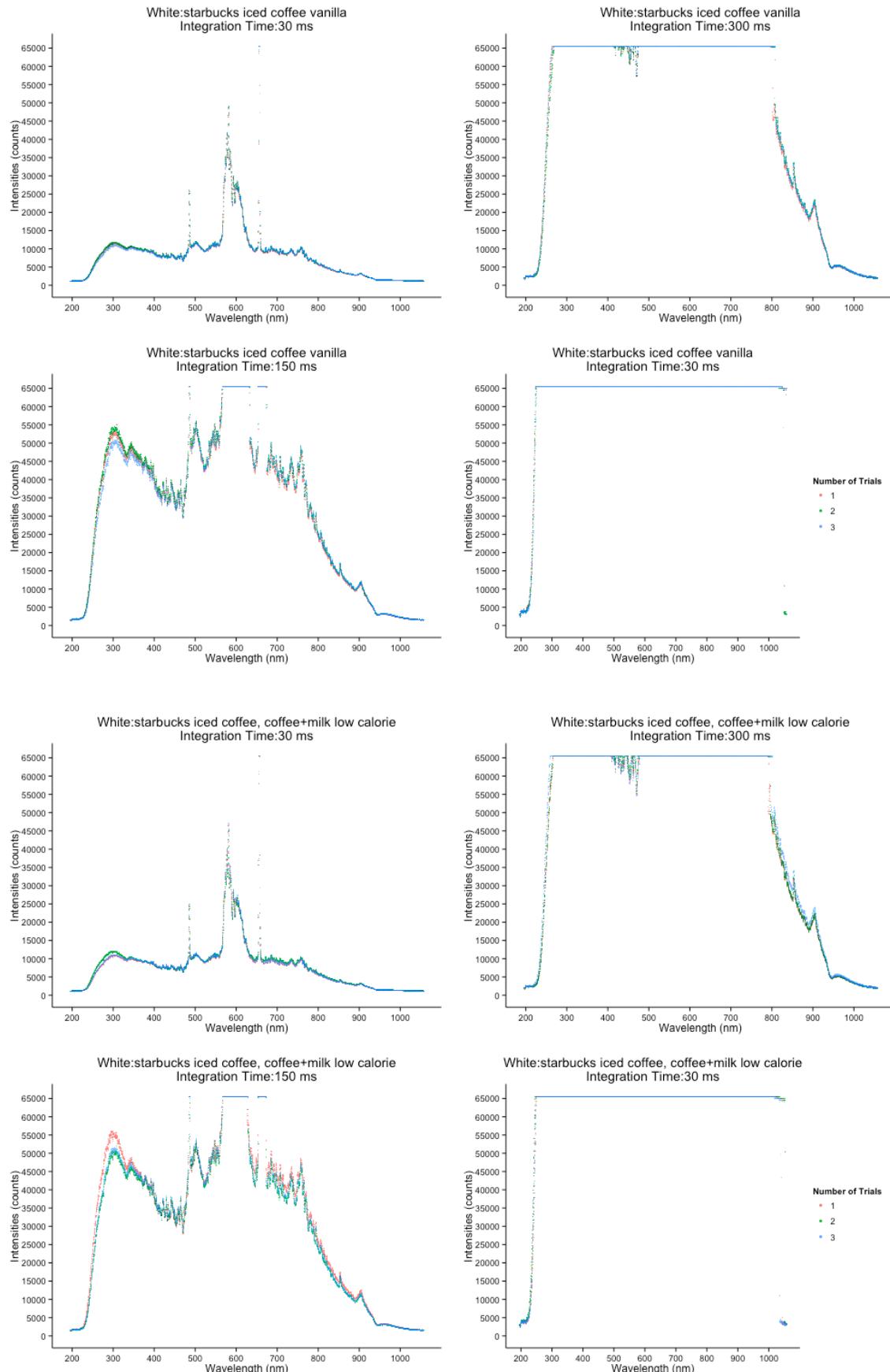


Coffee

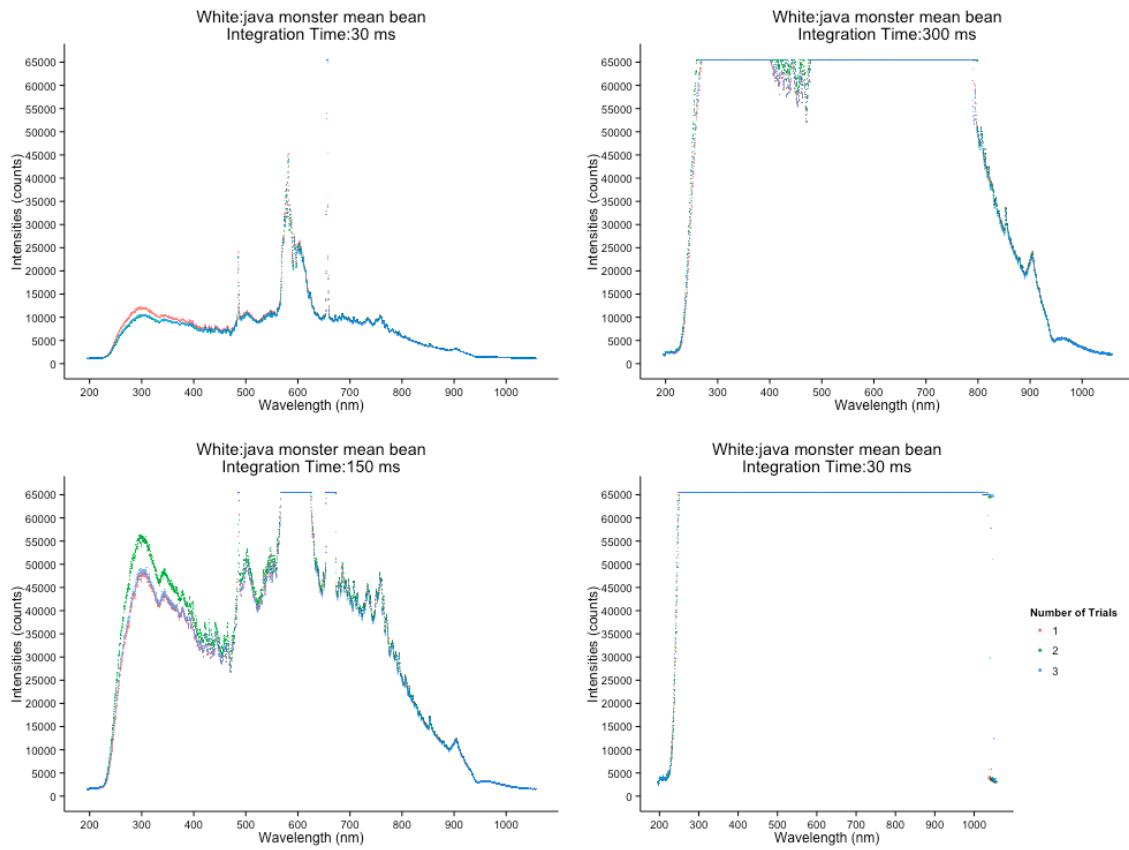


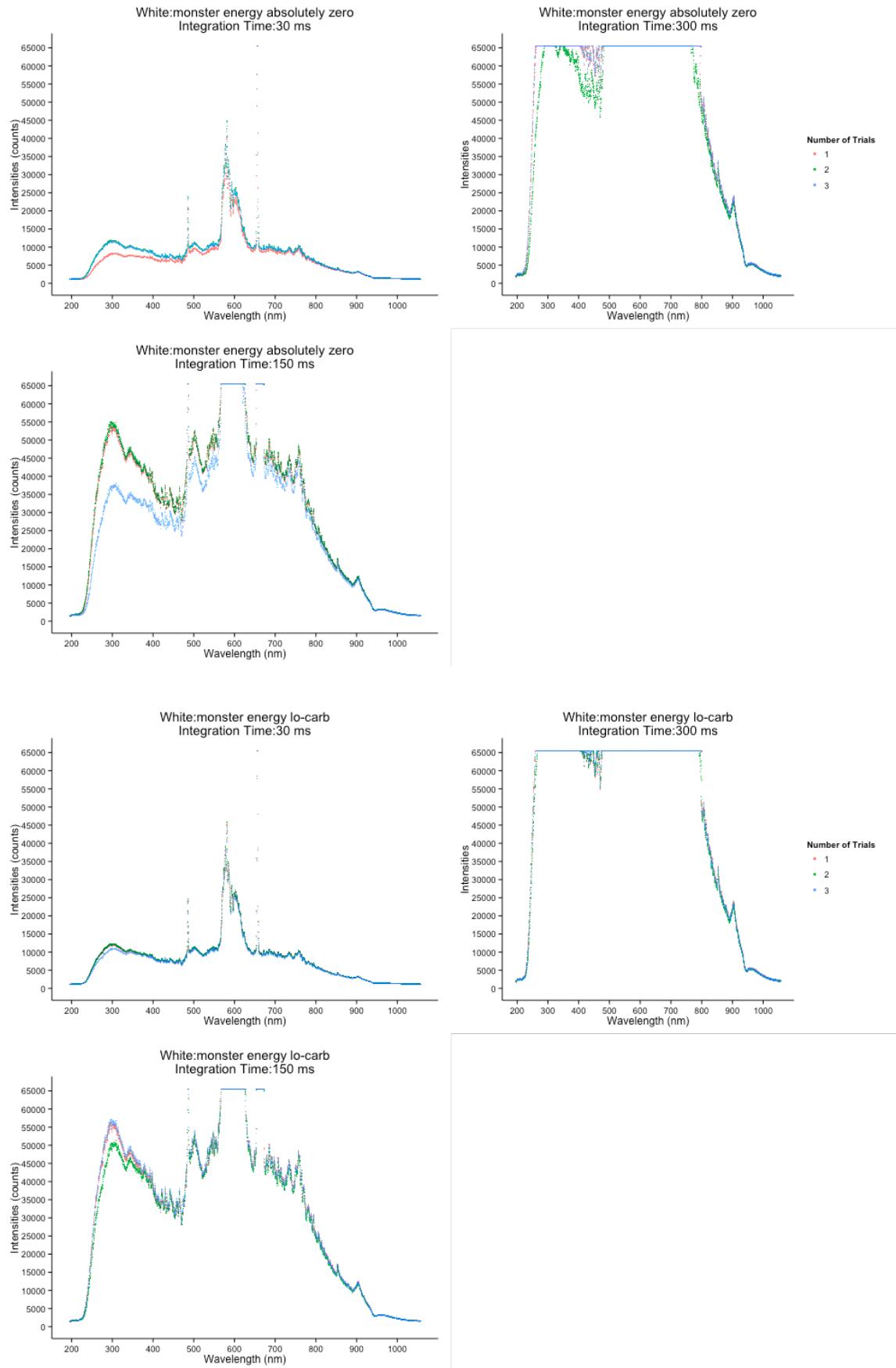


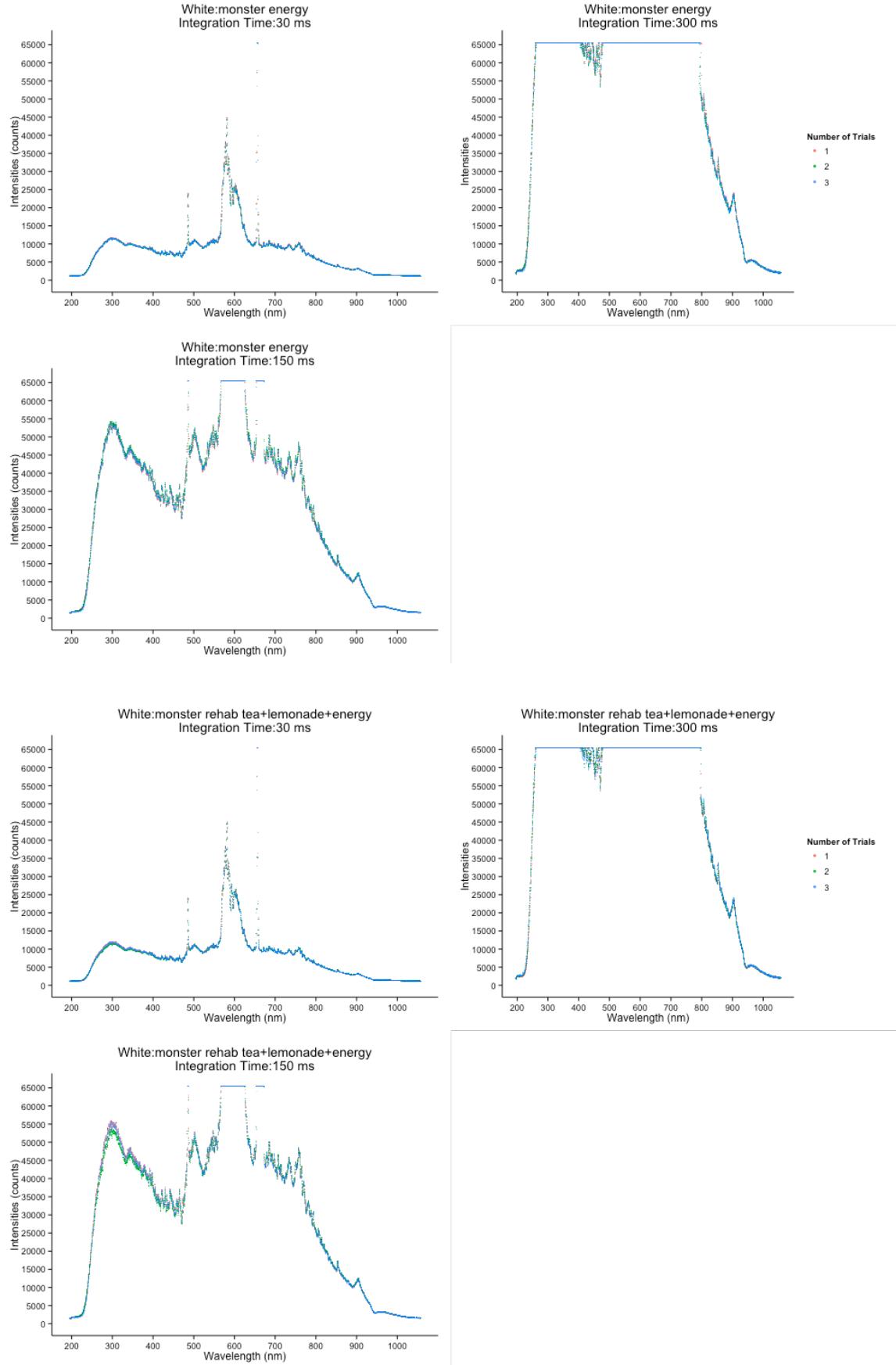


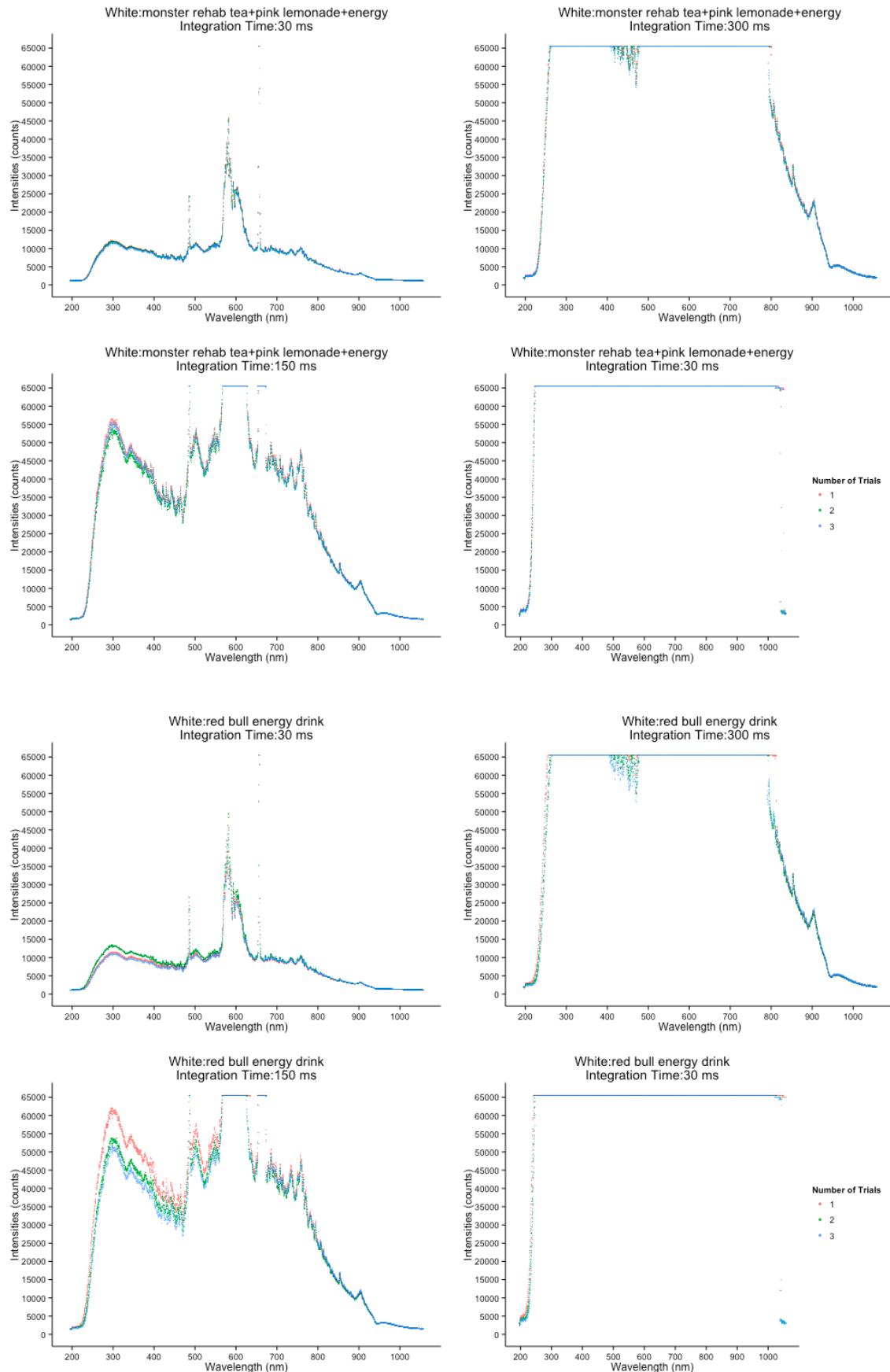


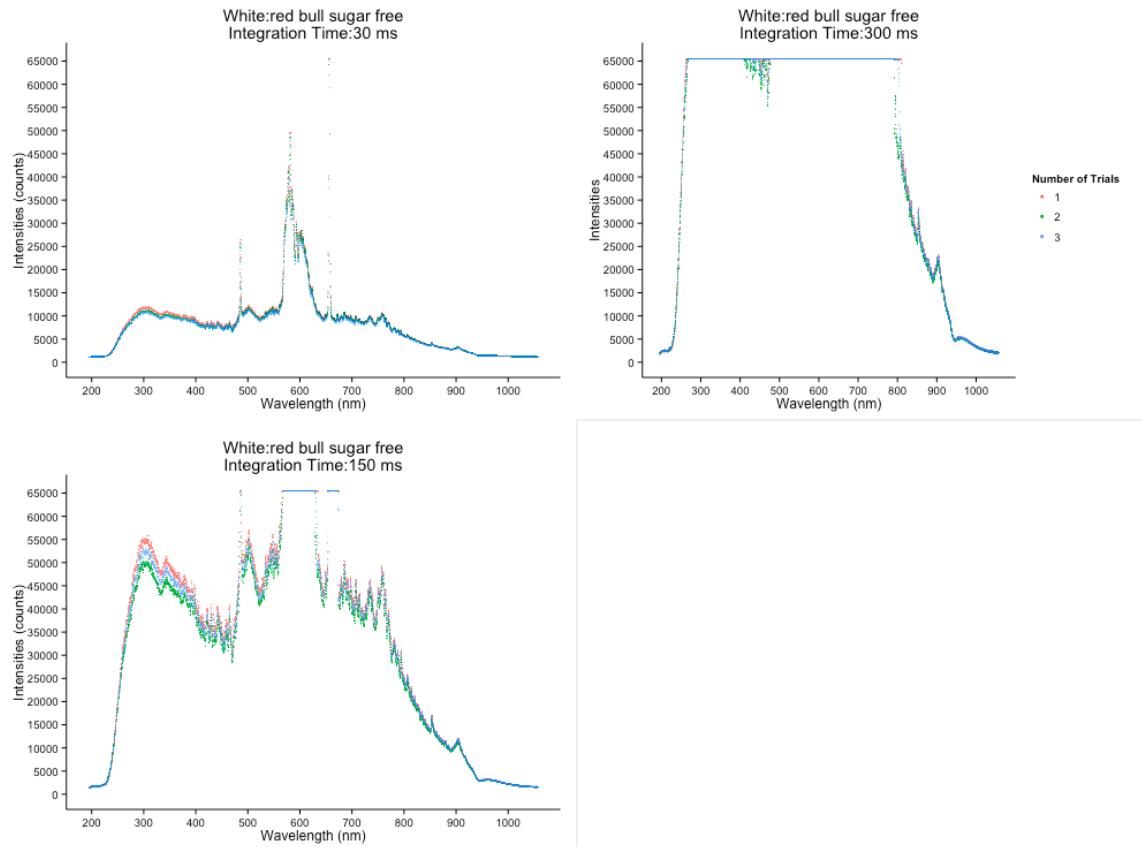
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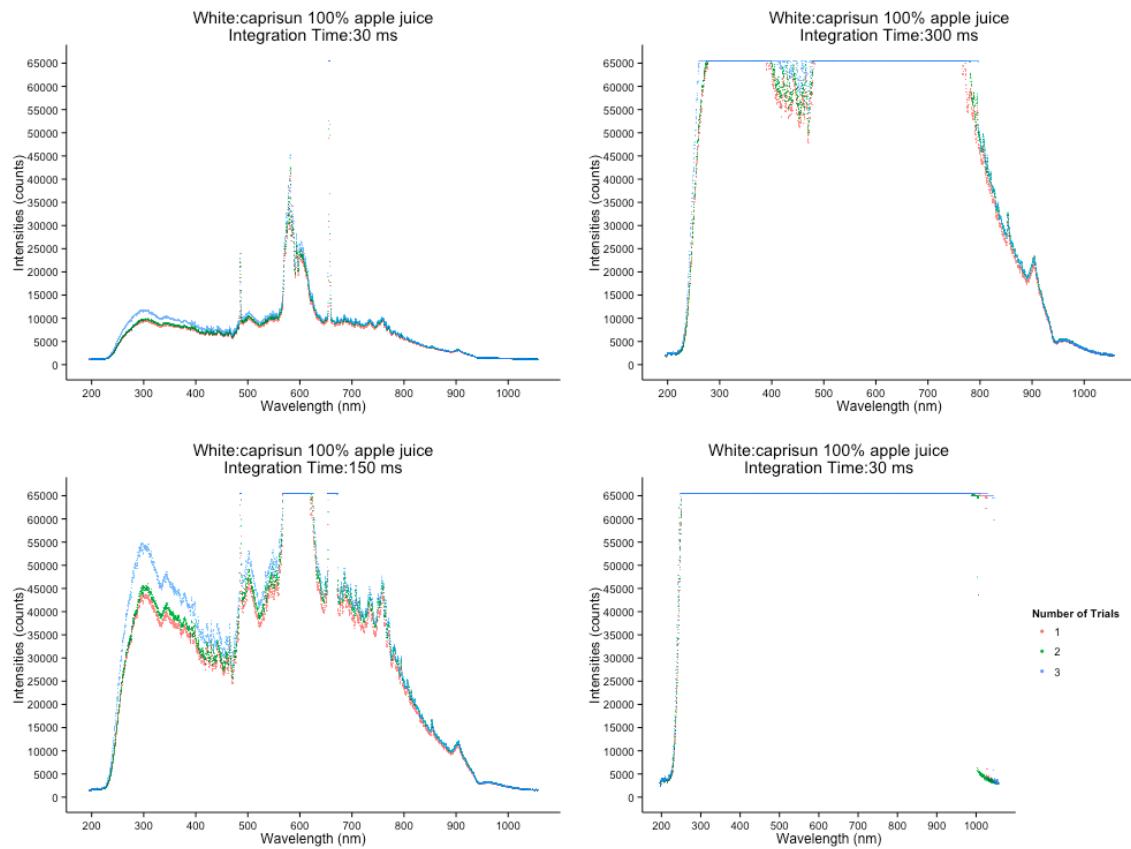


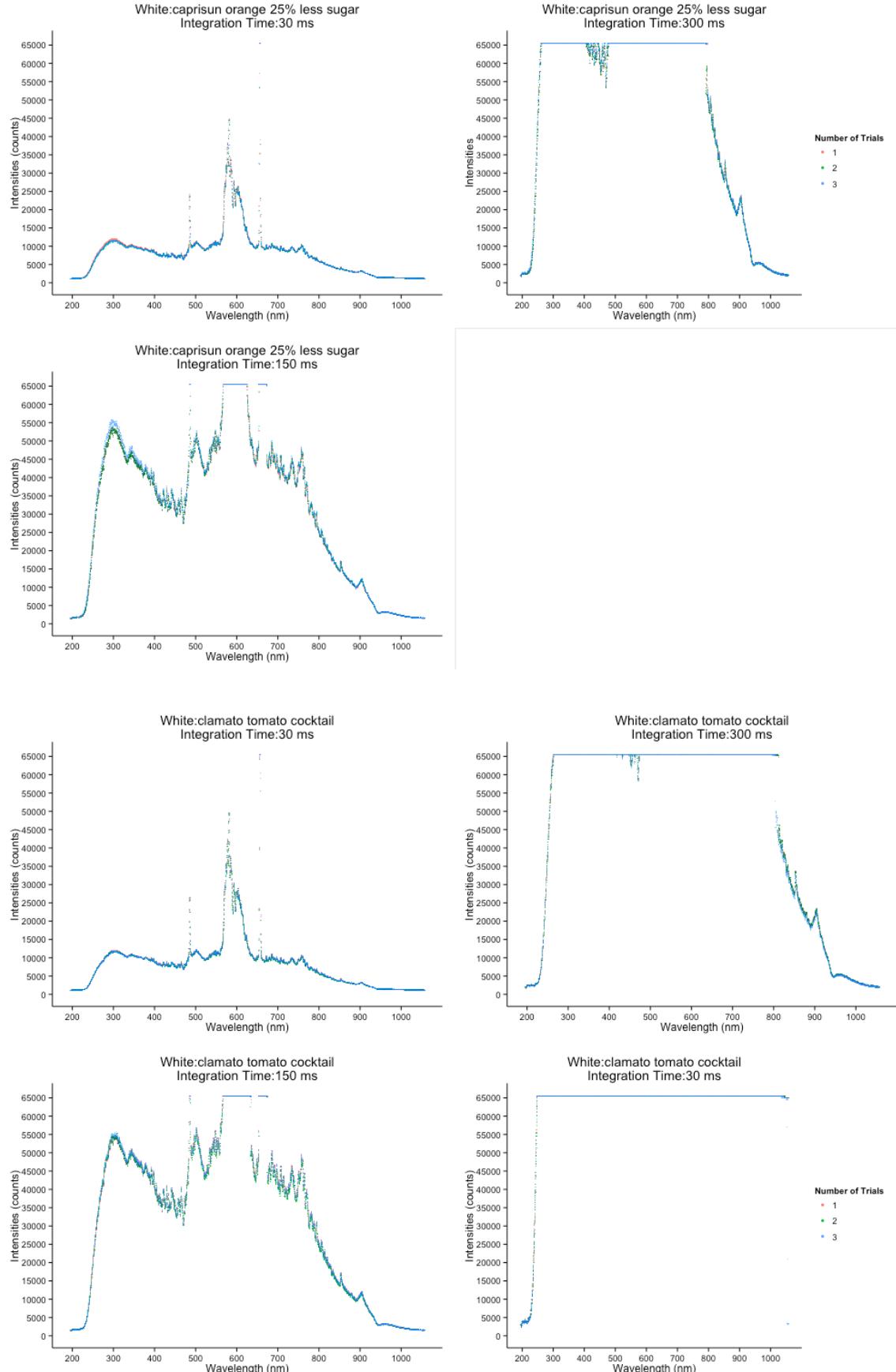


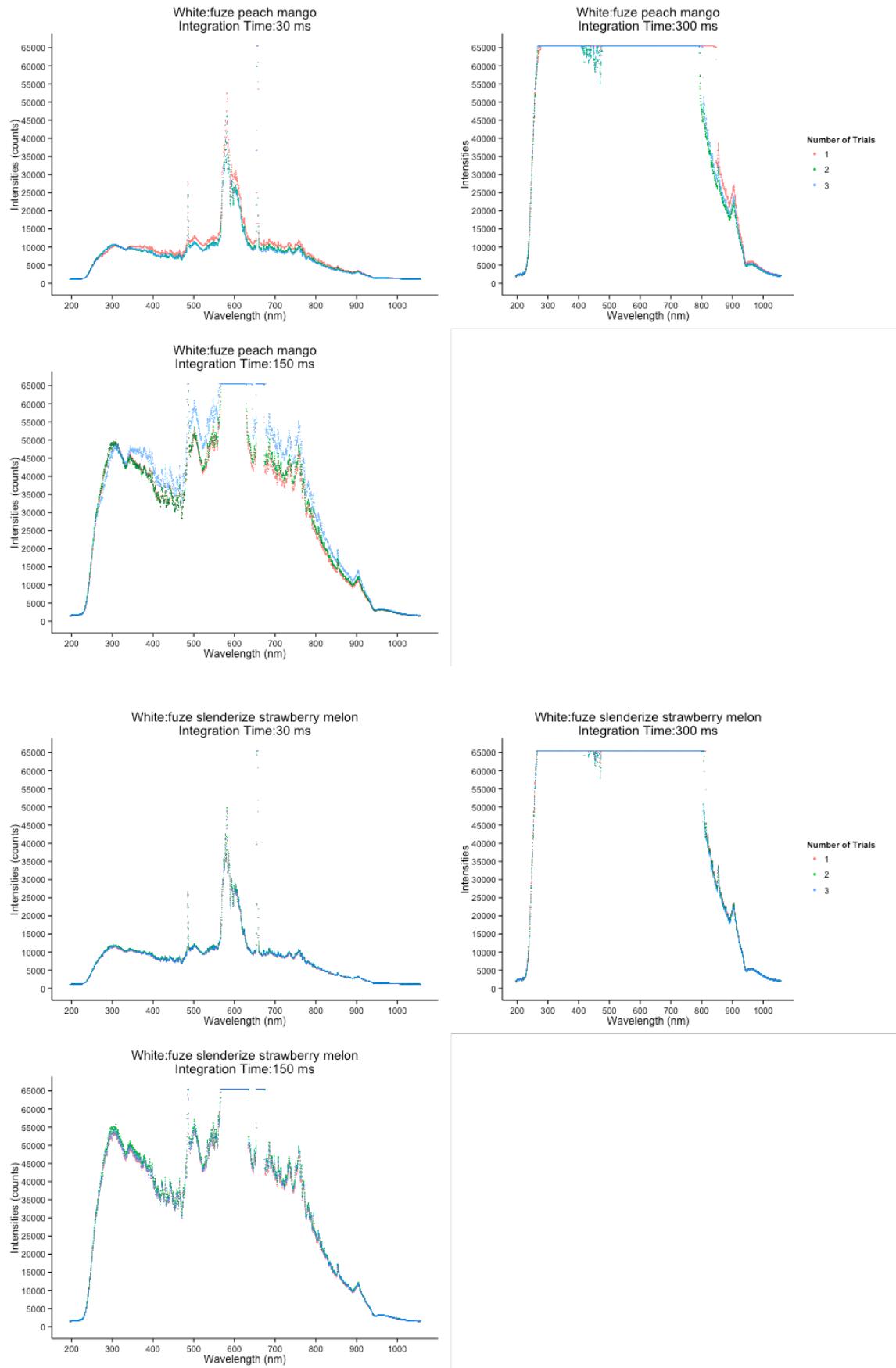


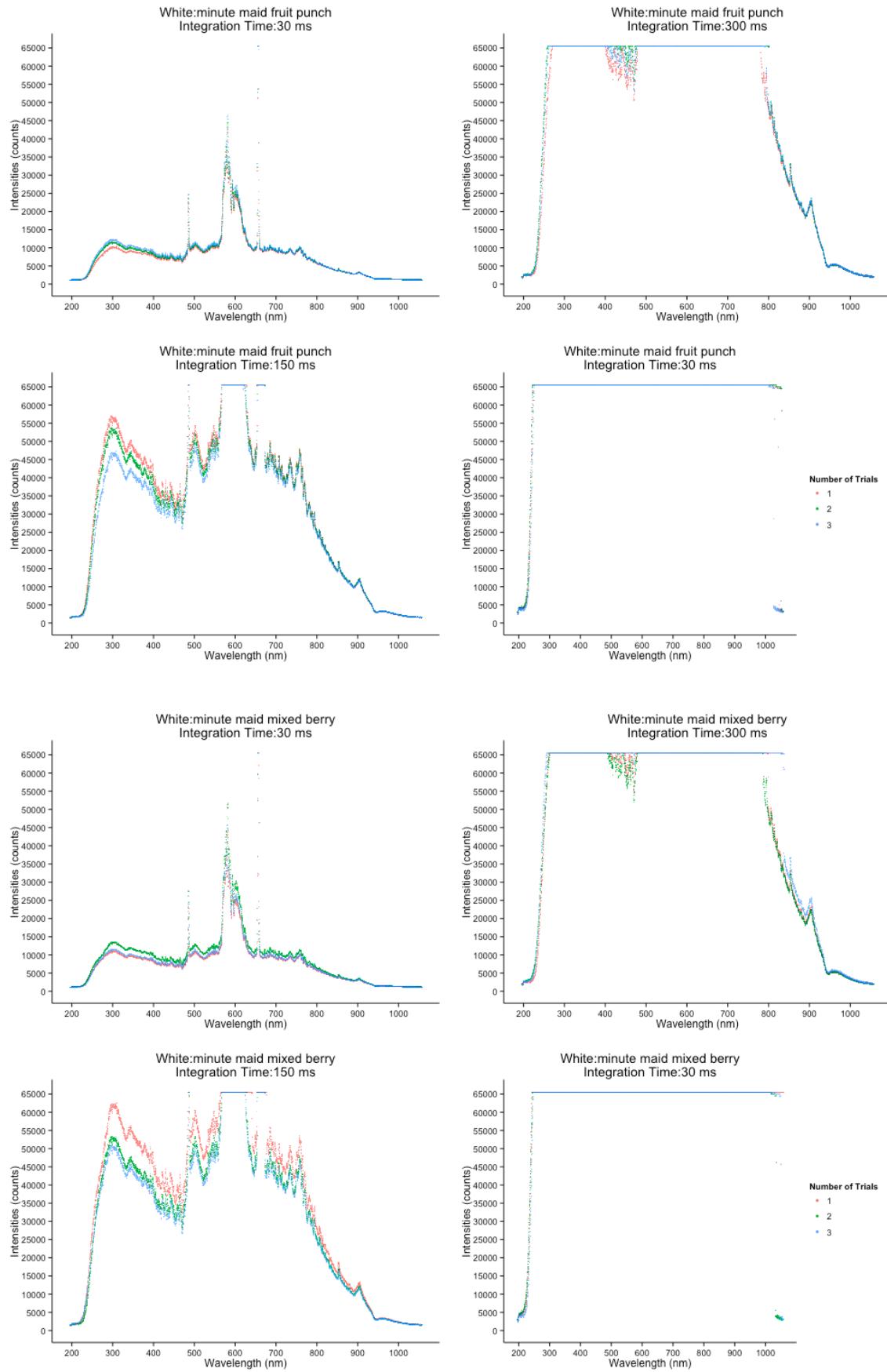


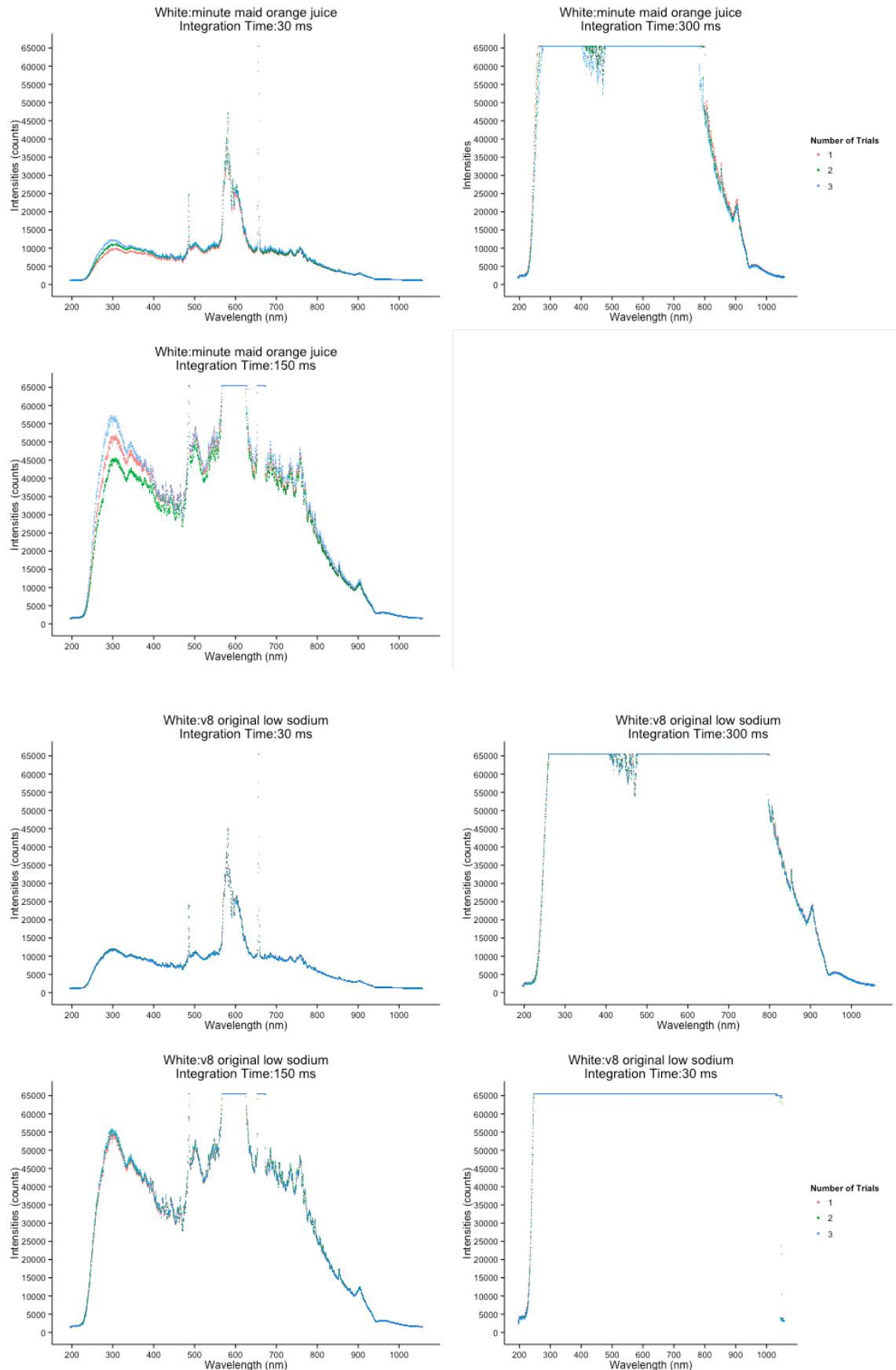
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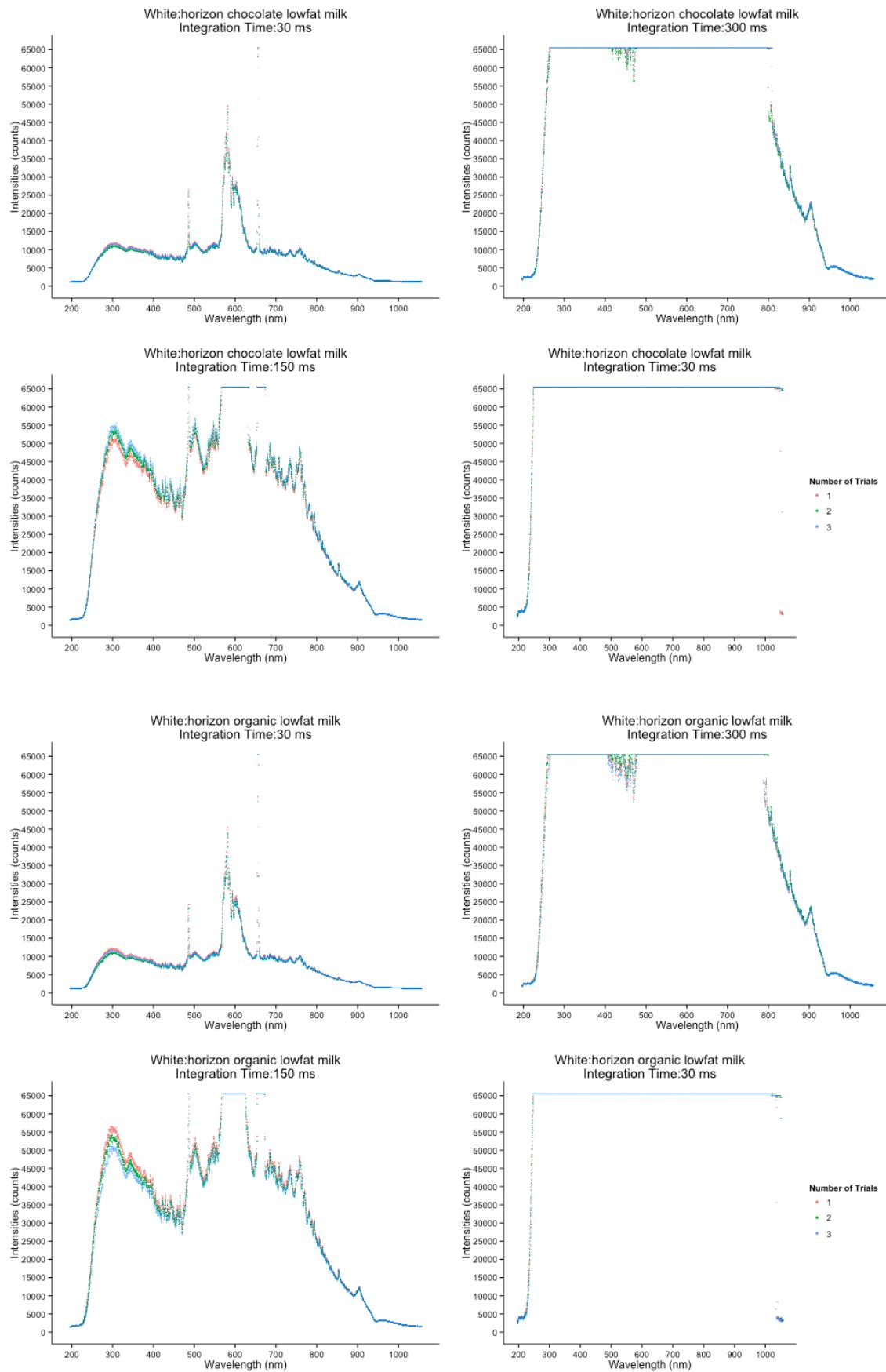


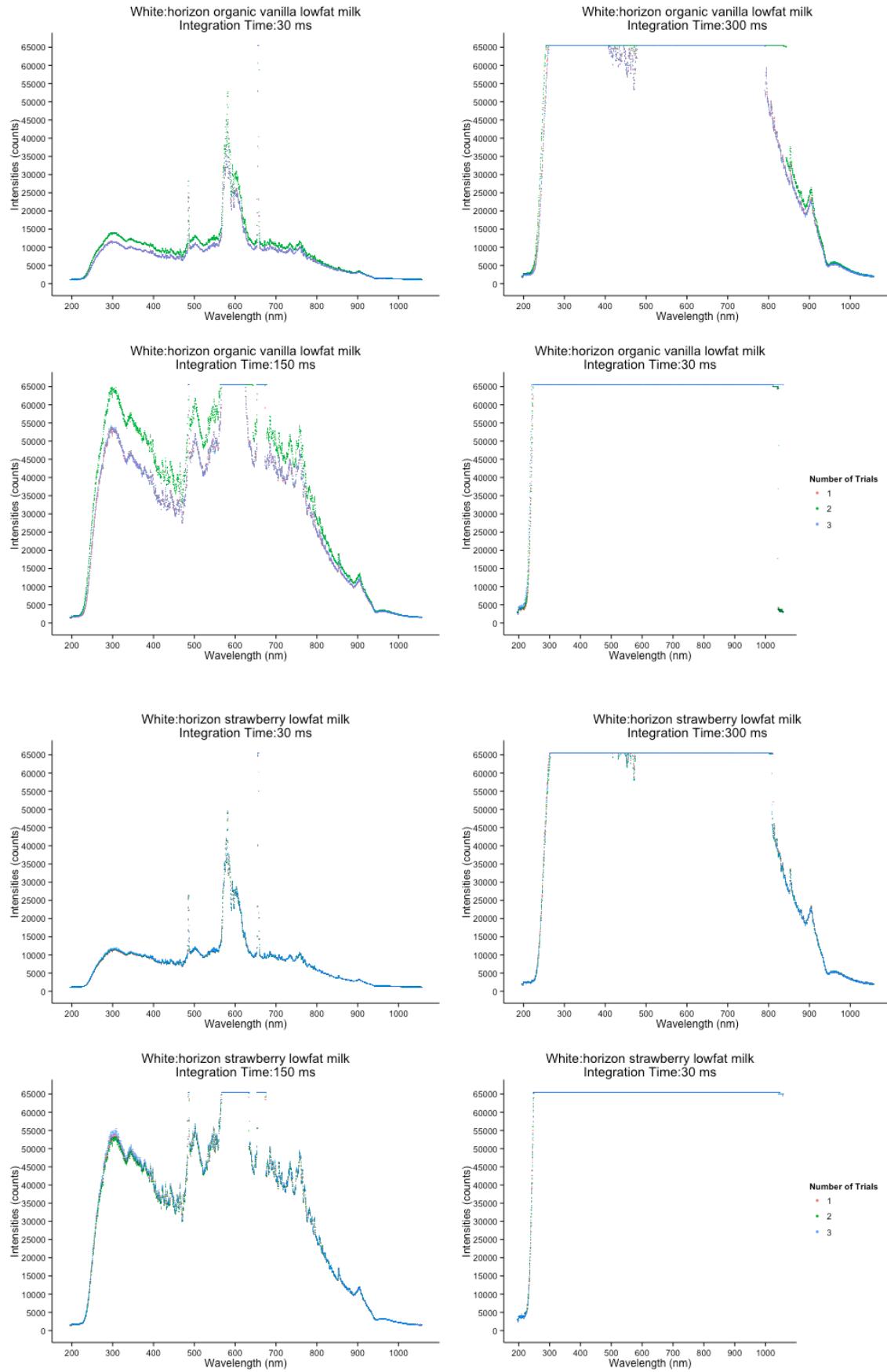


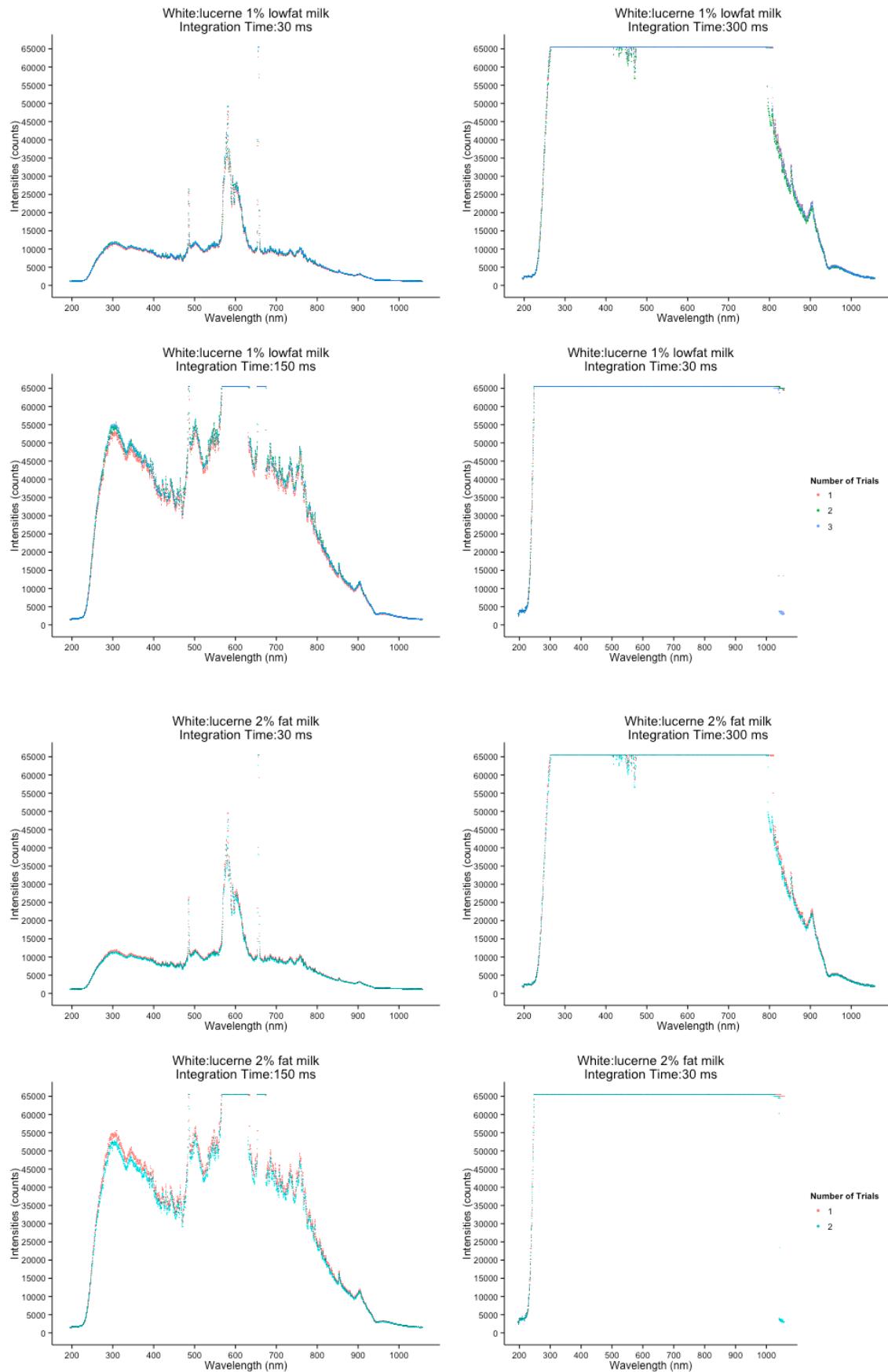


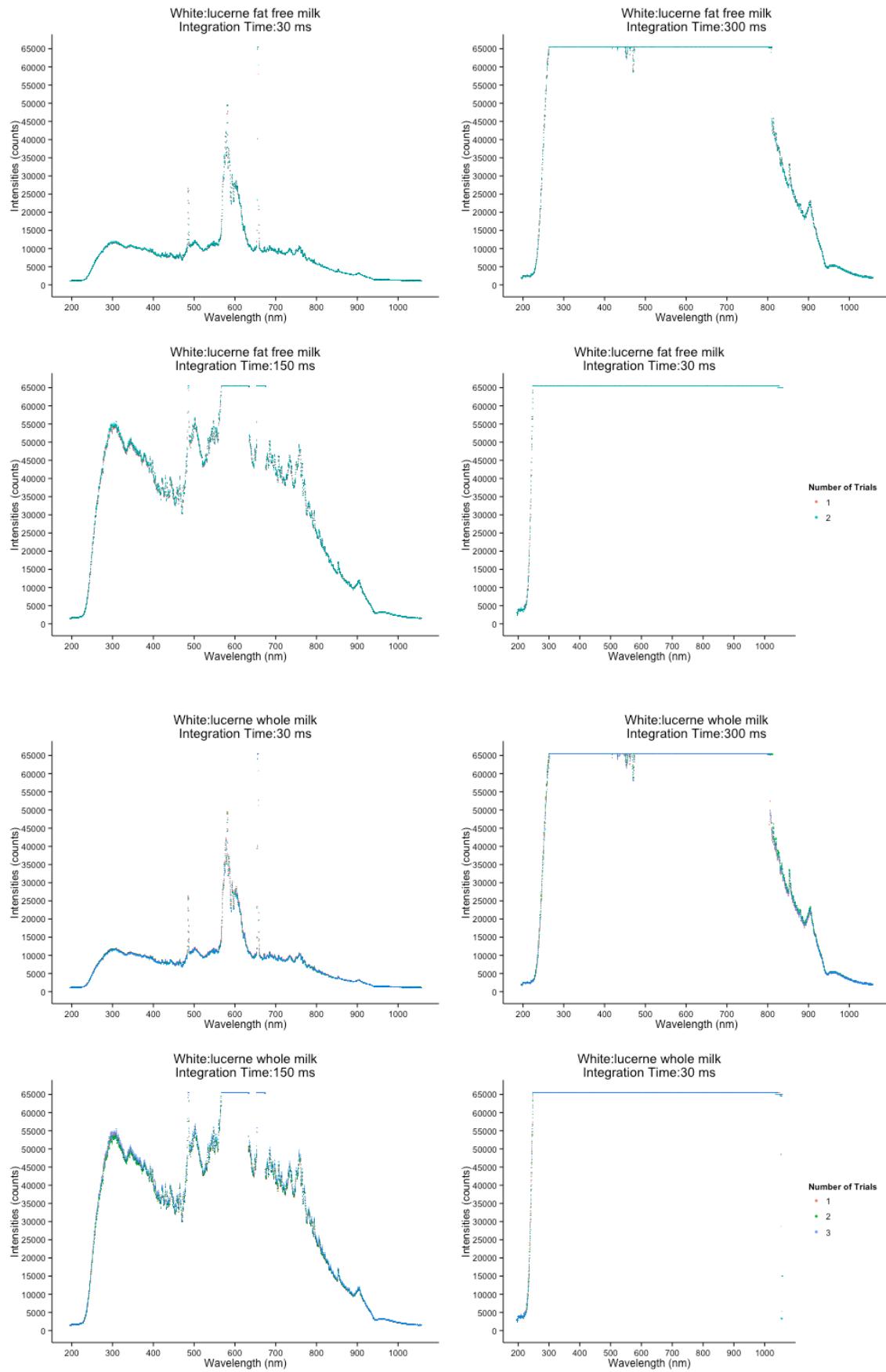


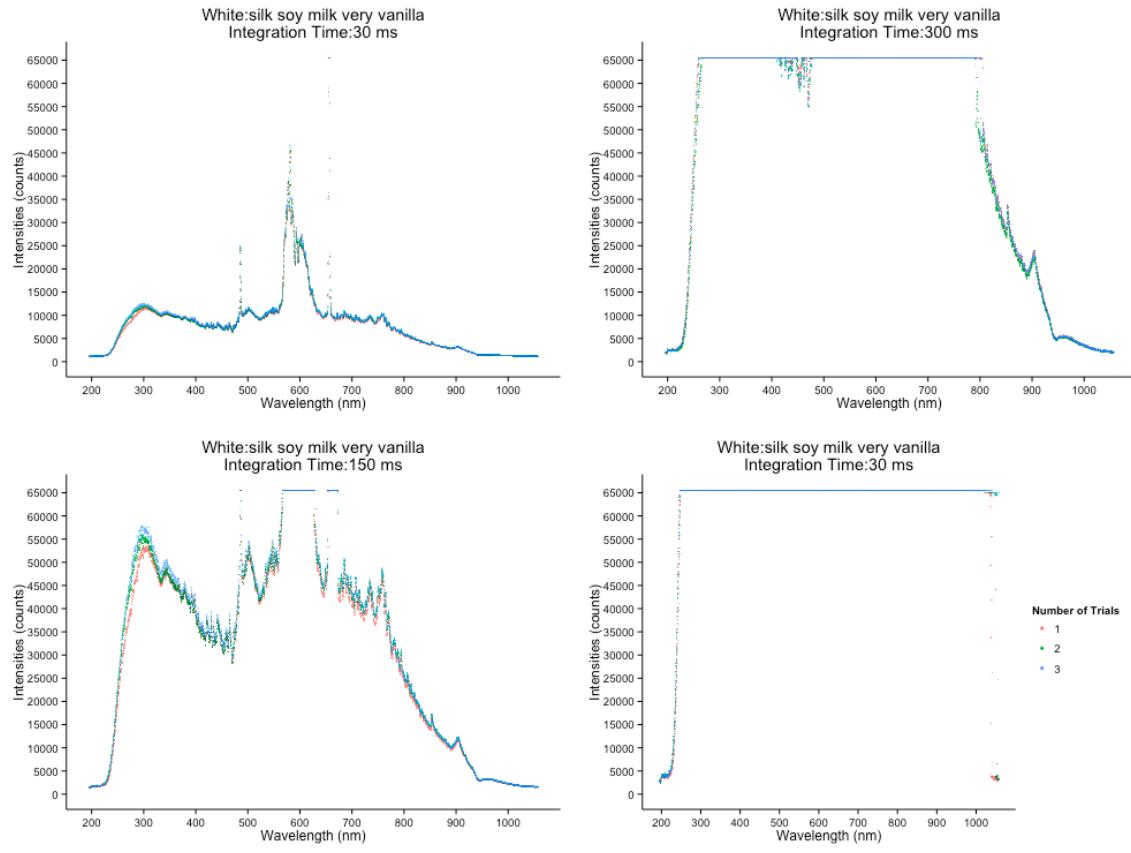
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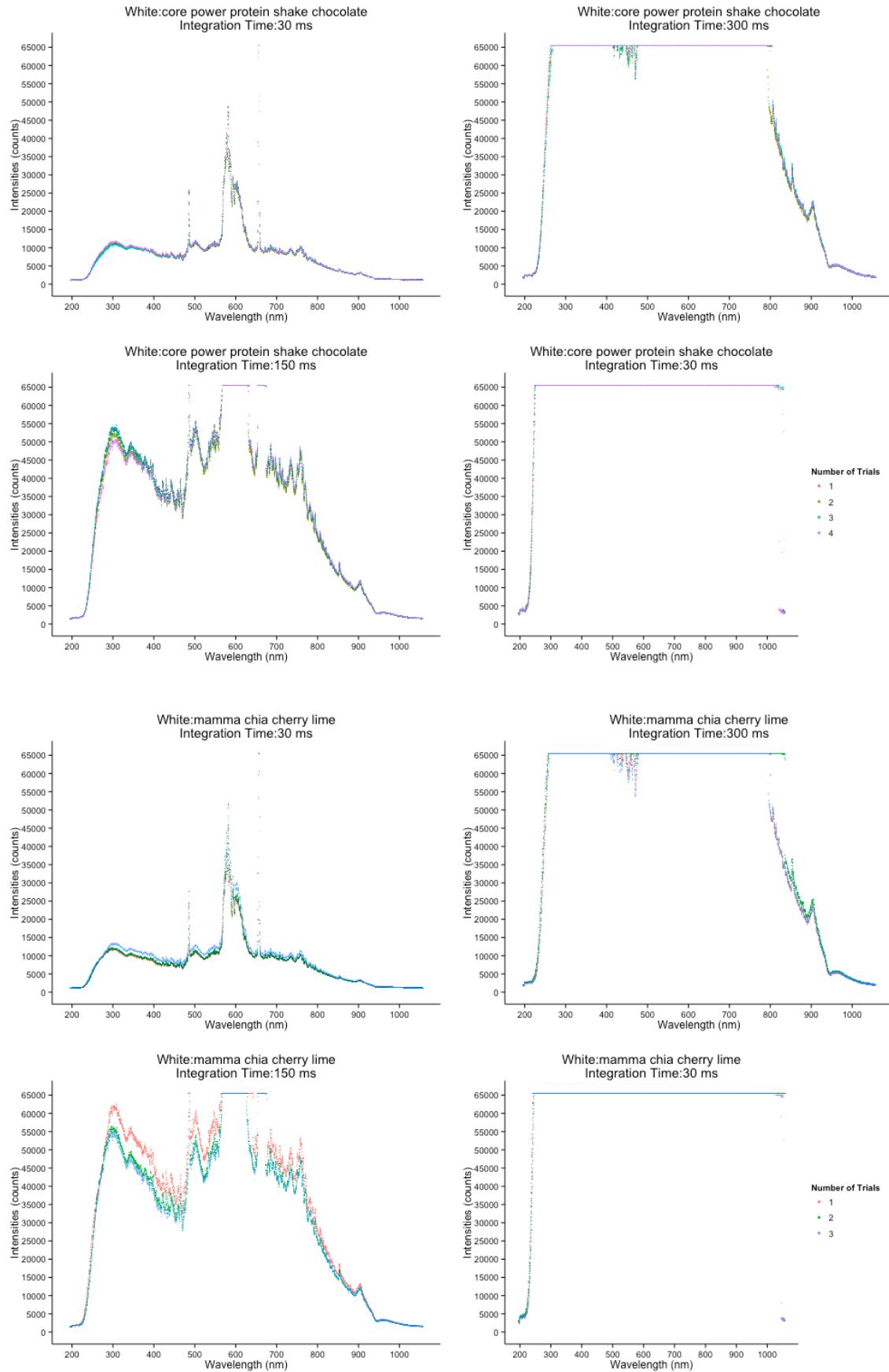


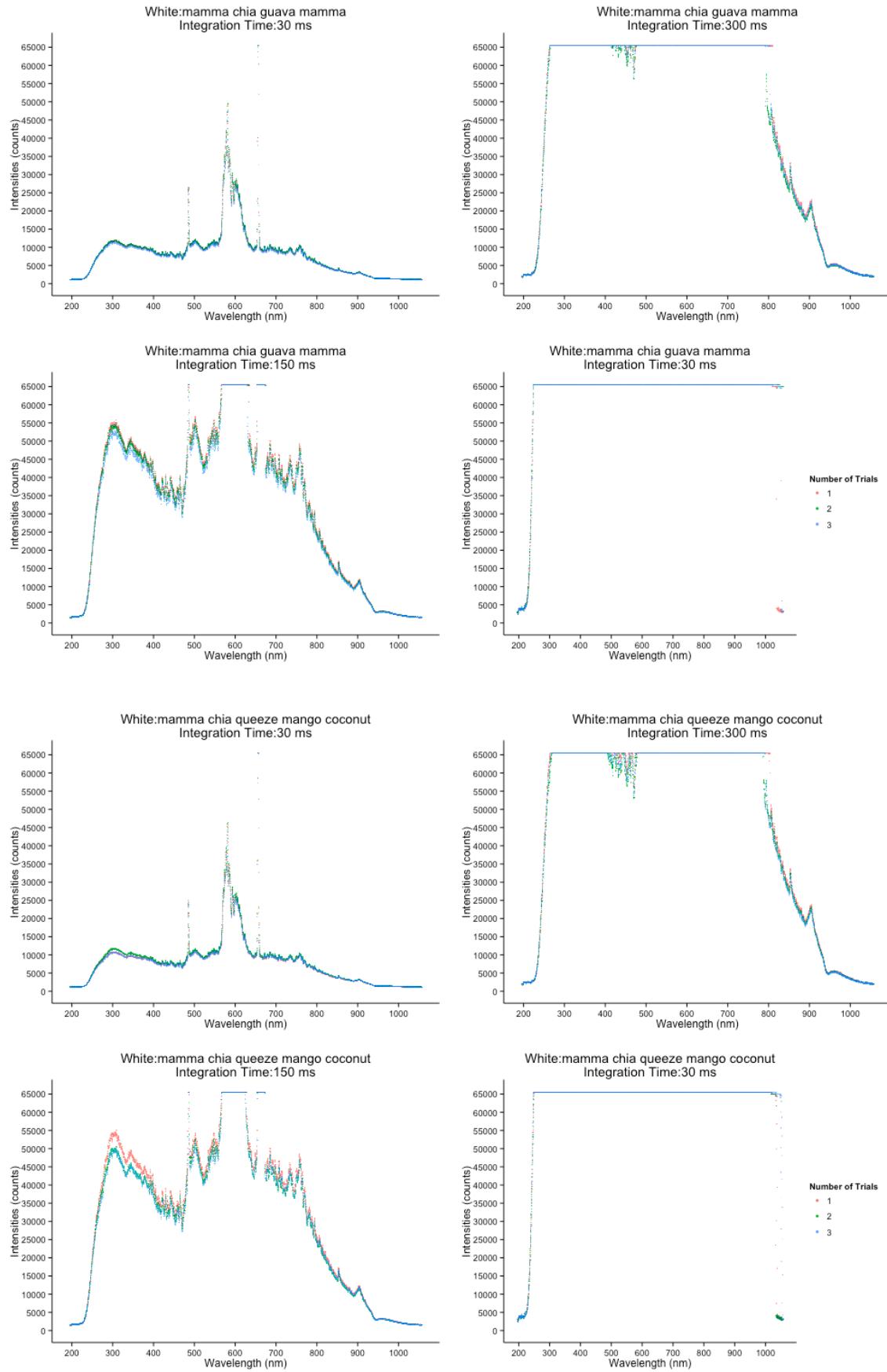


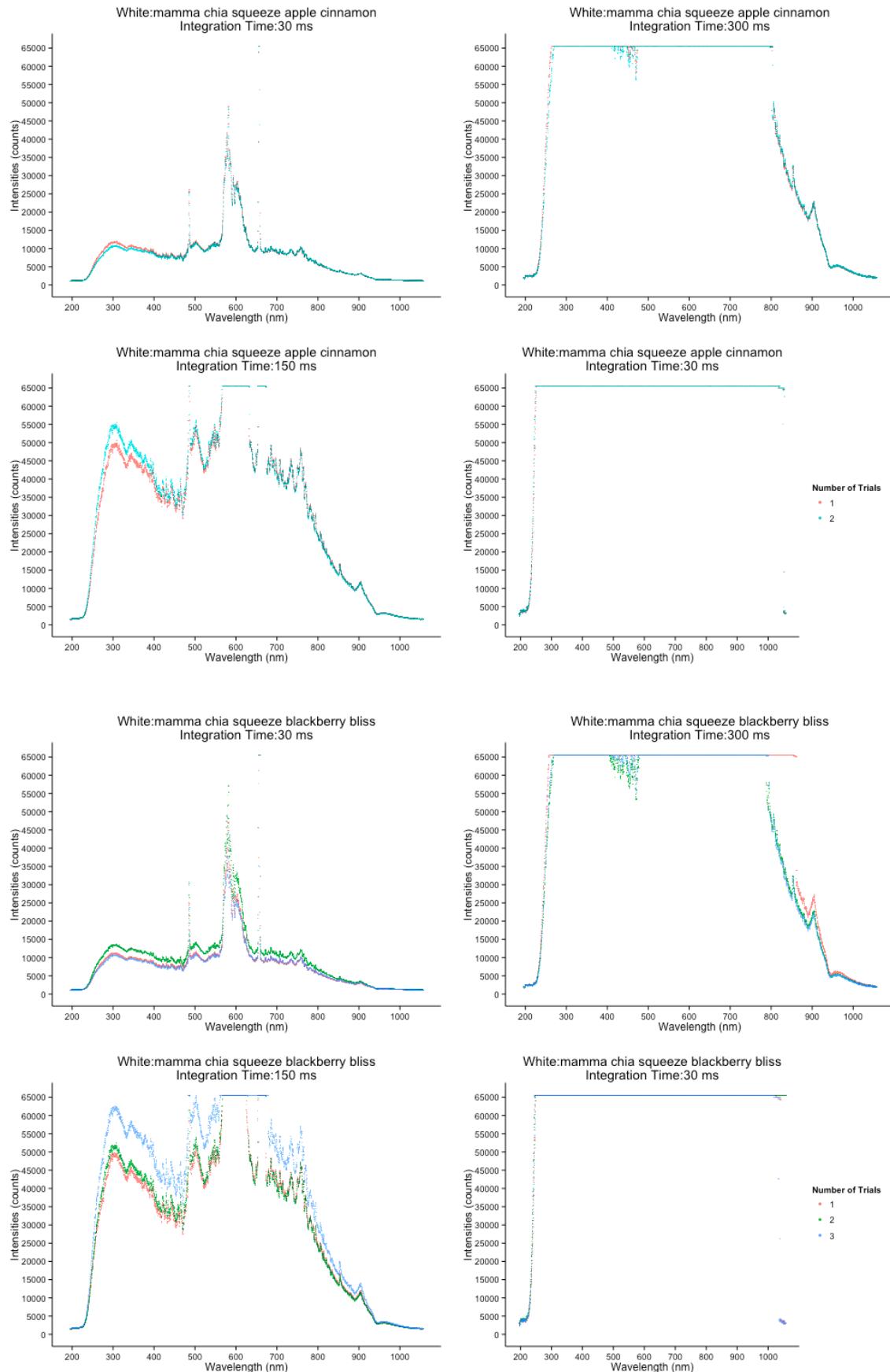


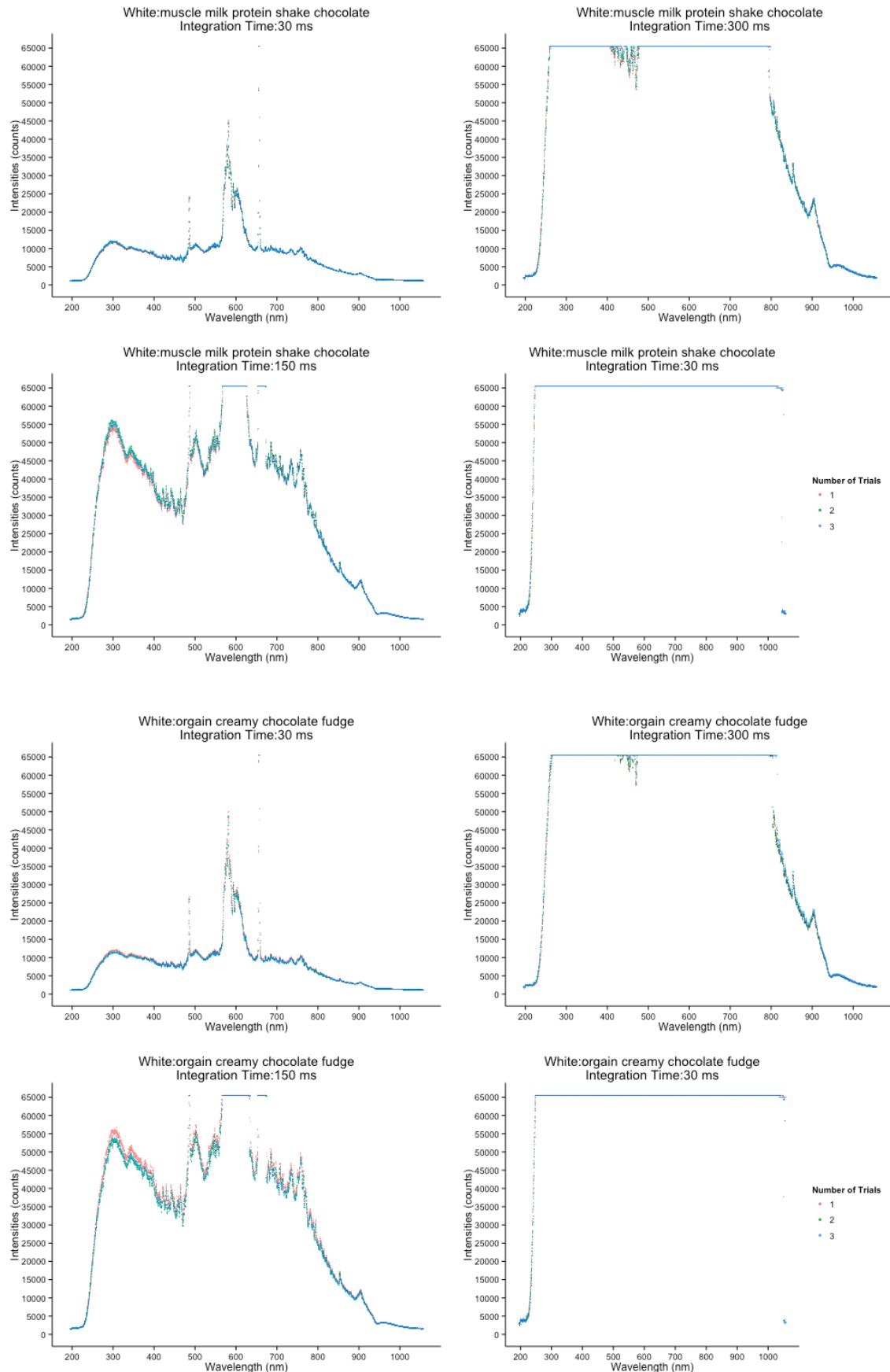


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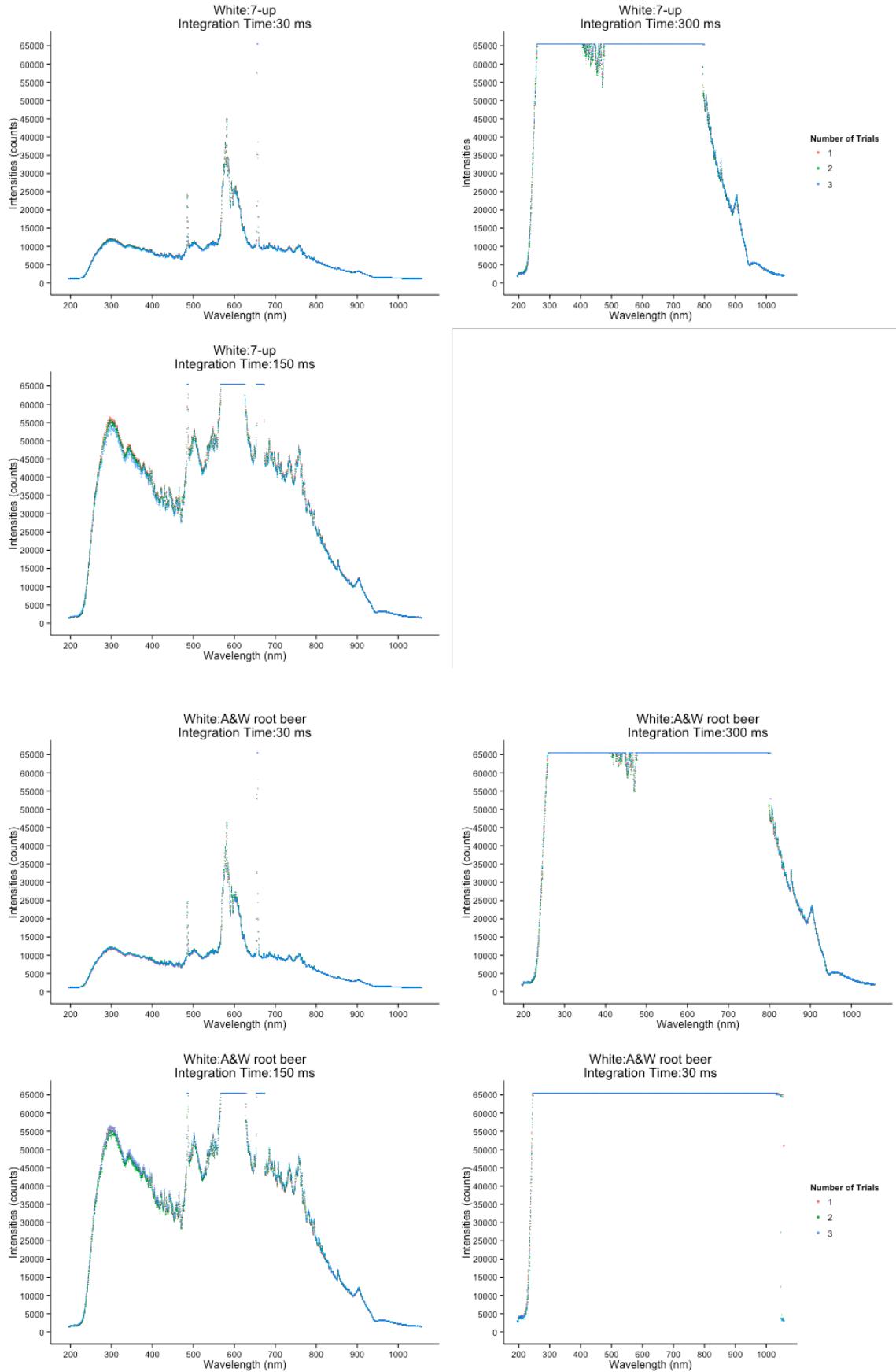


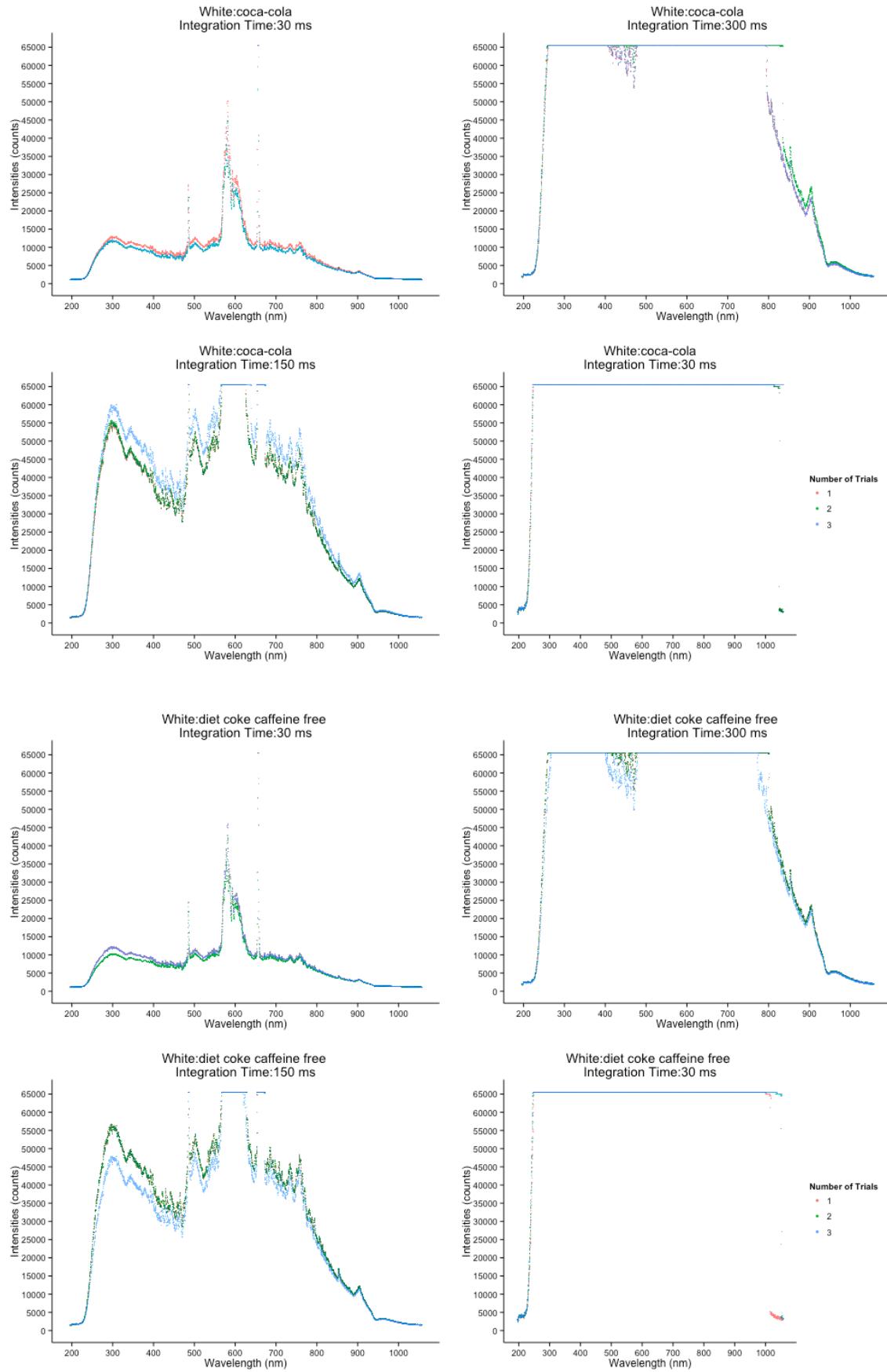


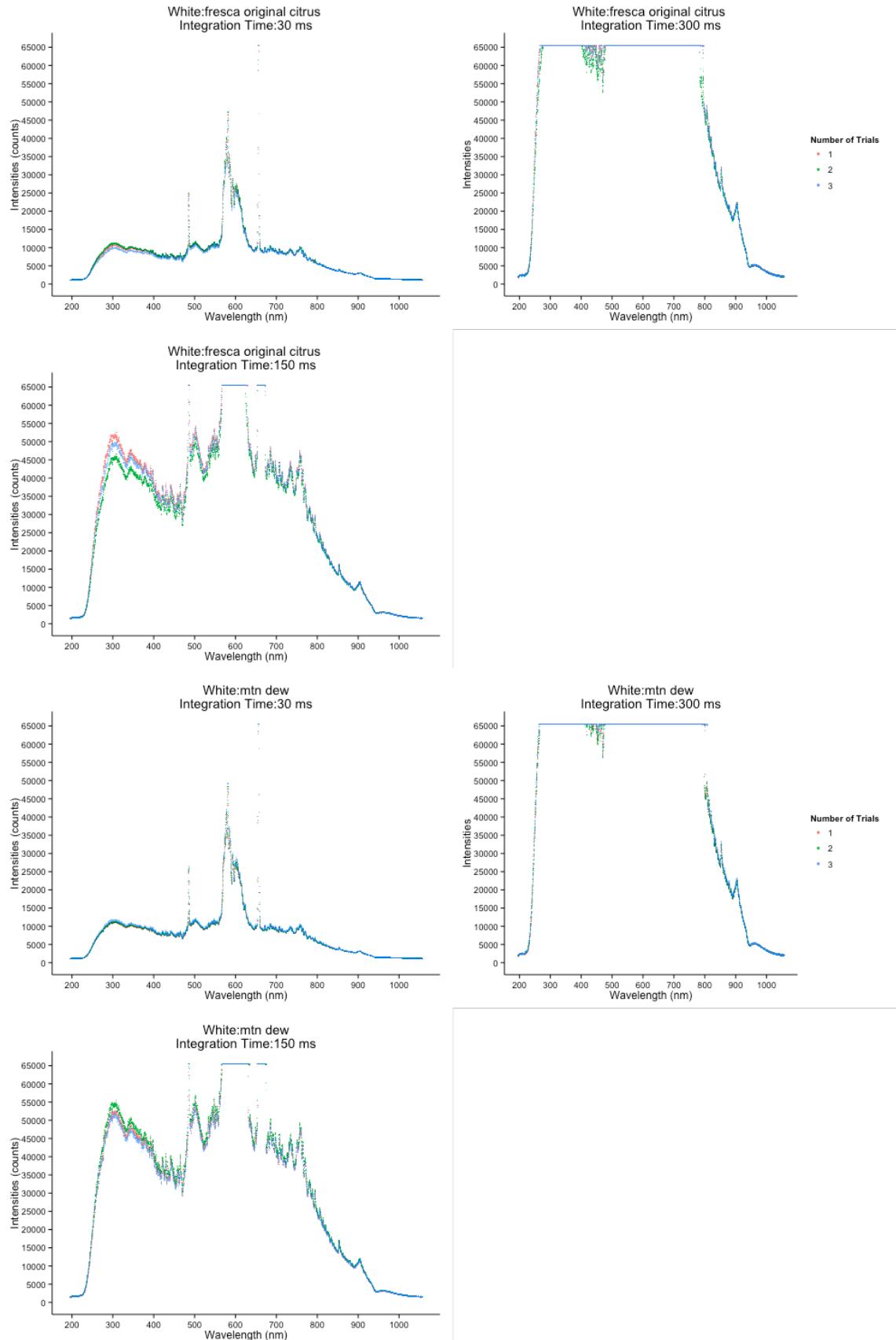


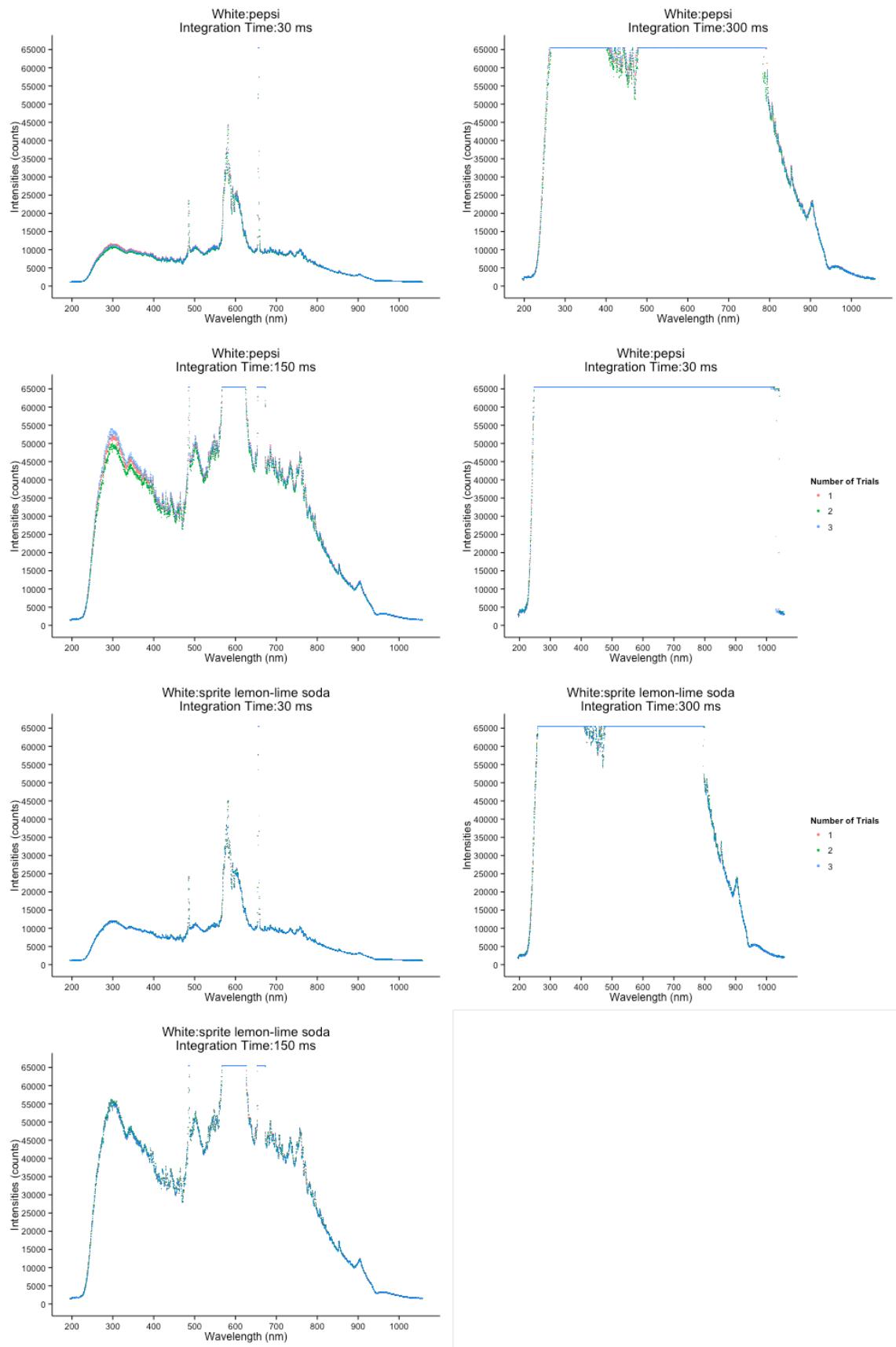


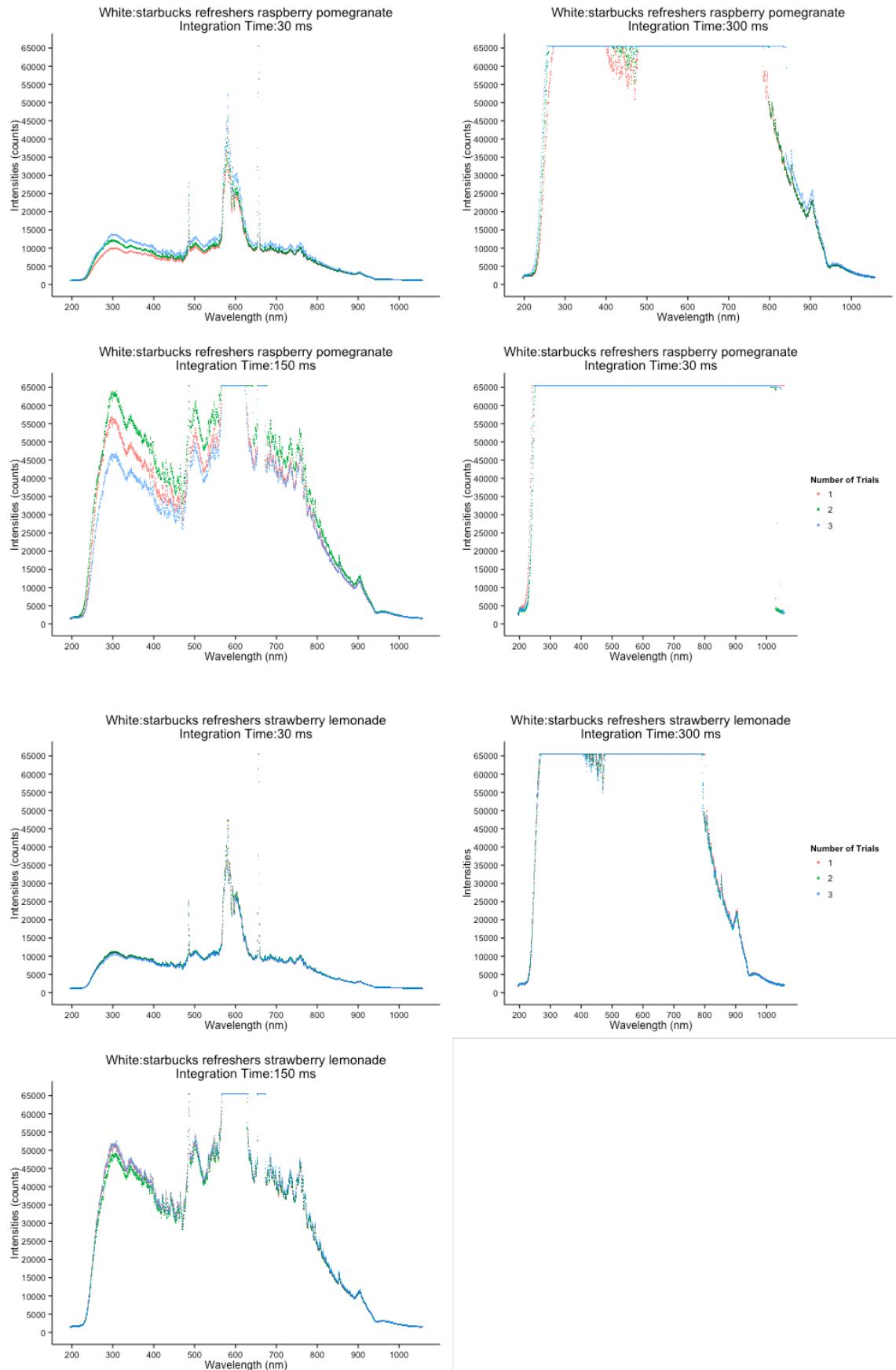
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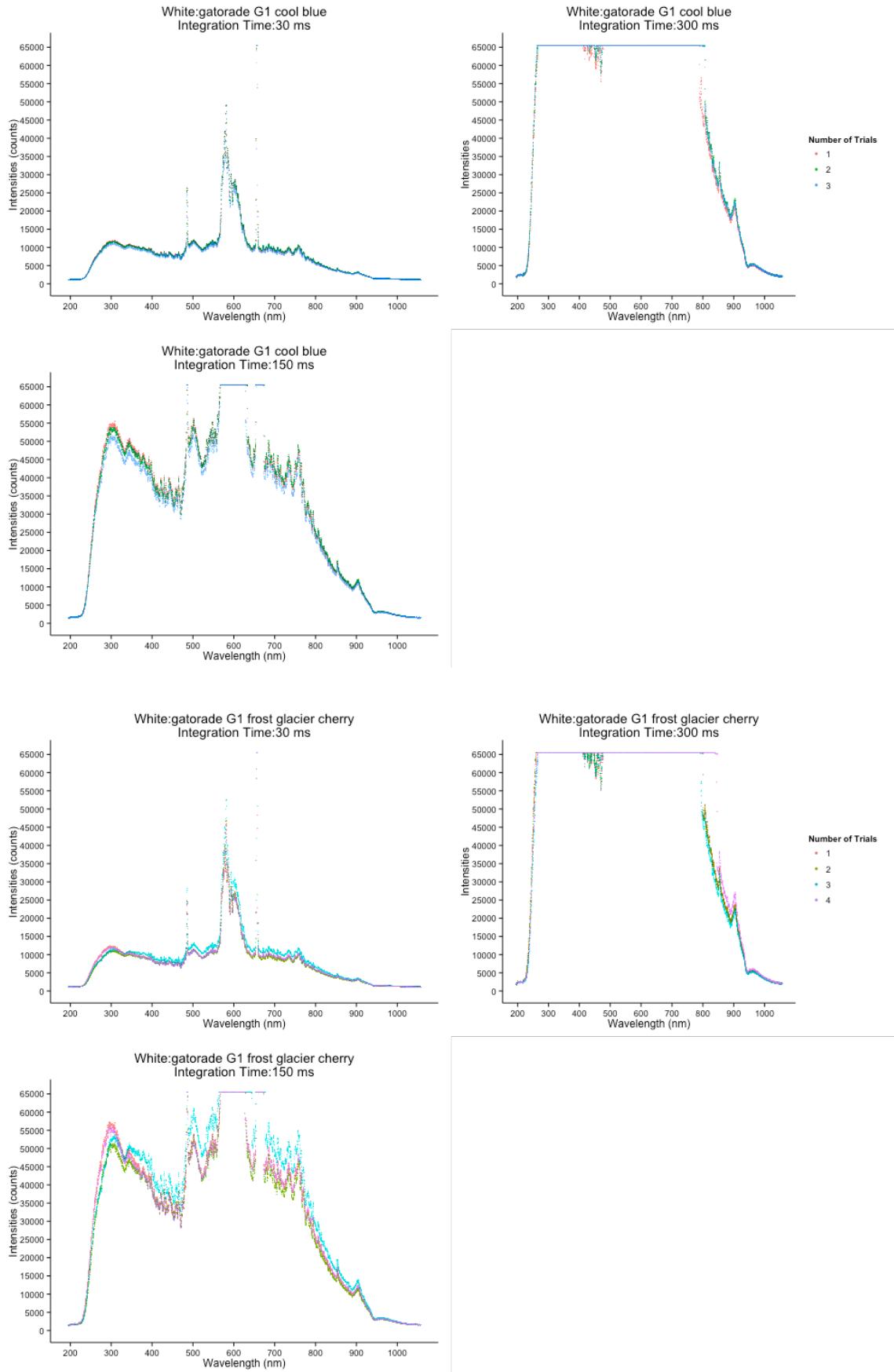


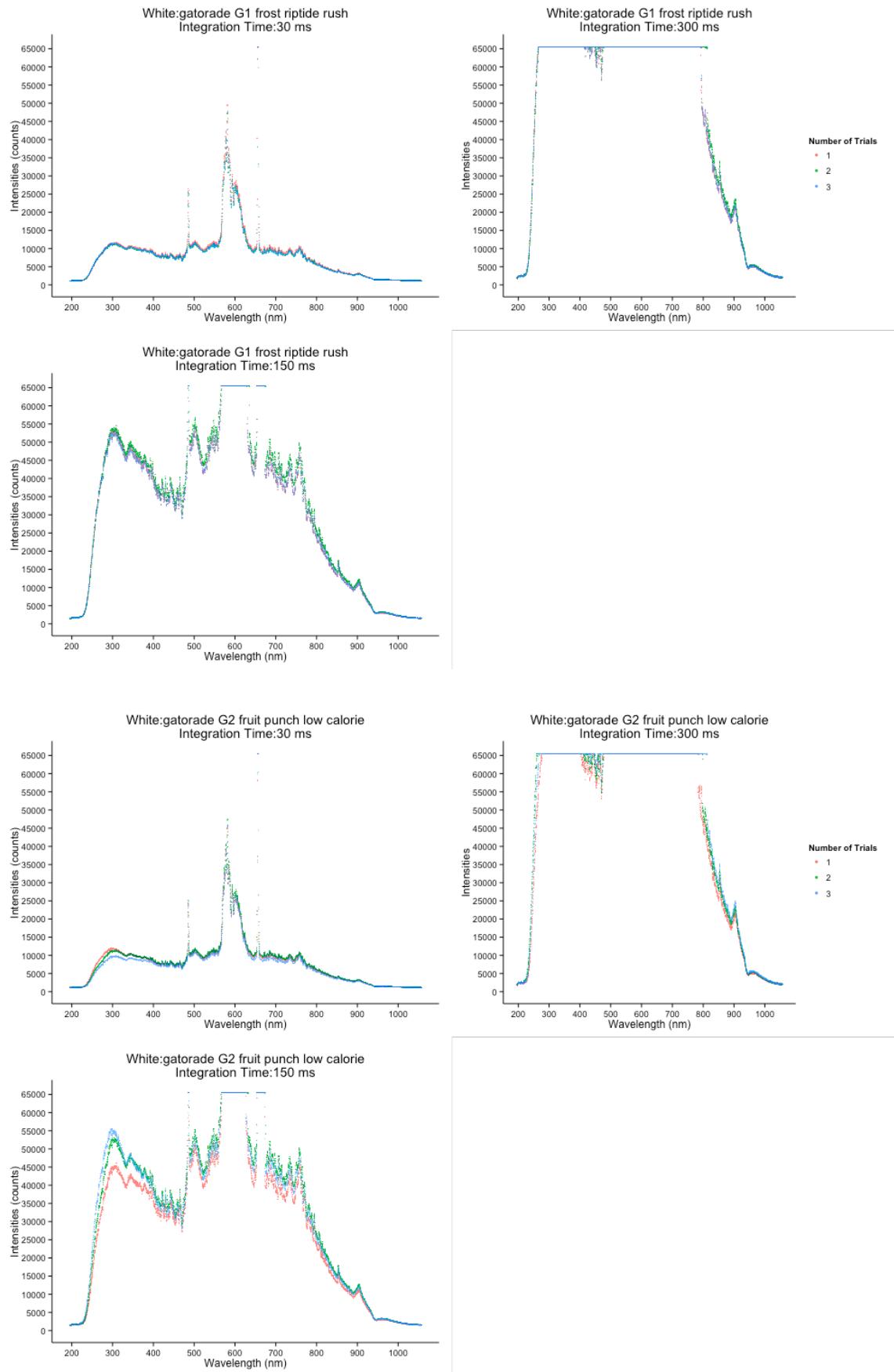


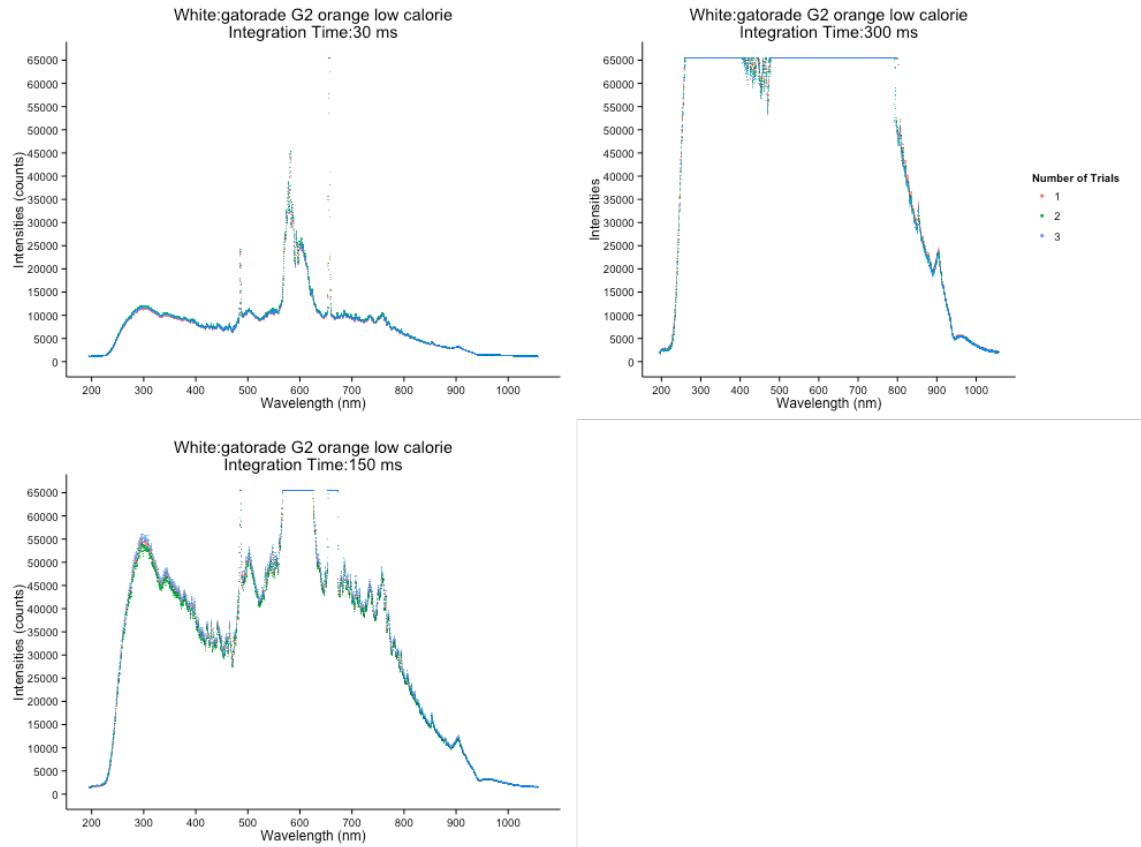




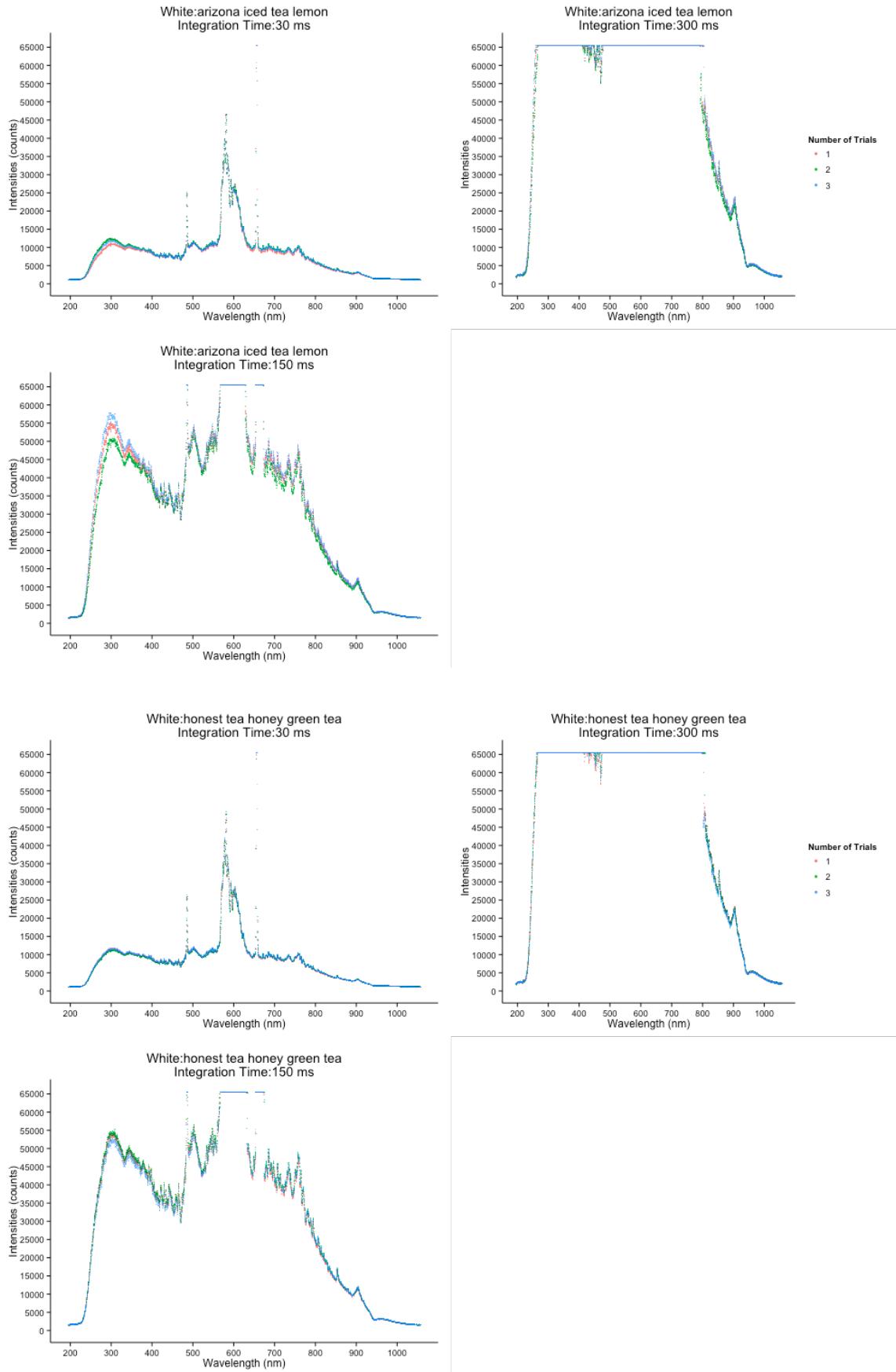
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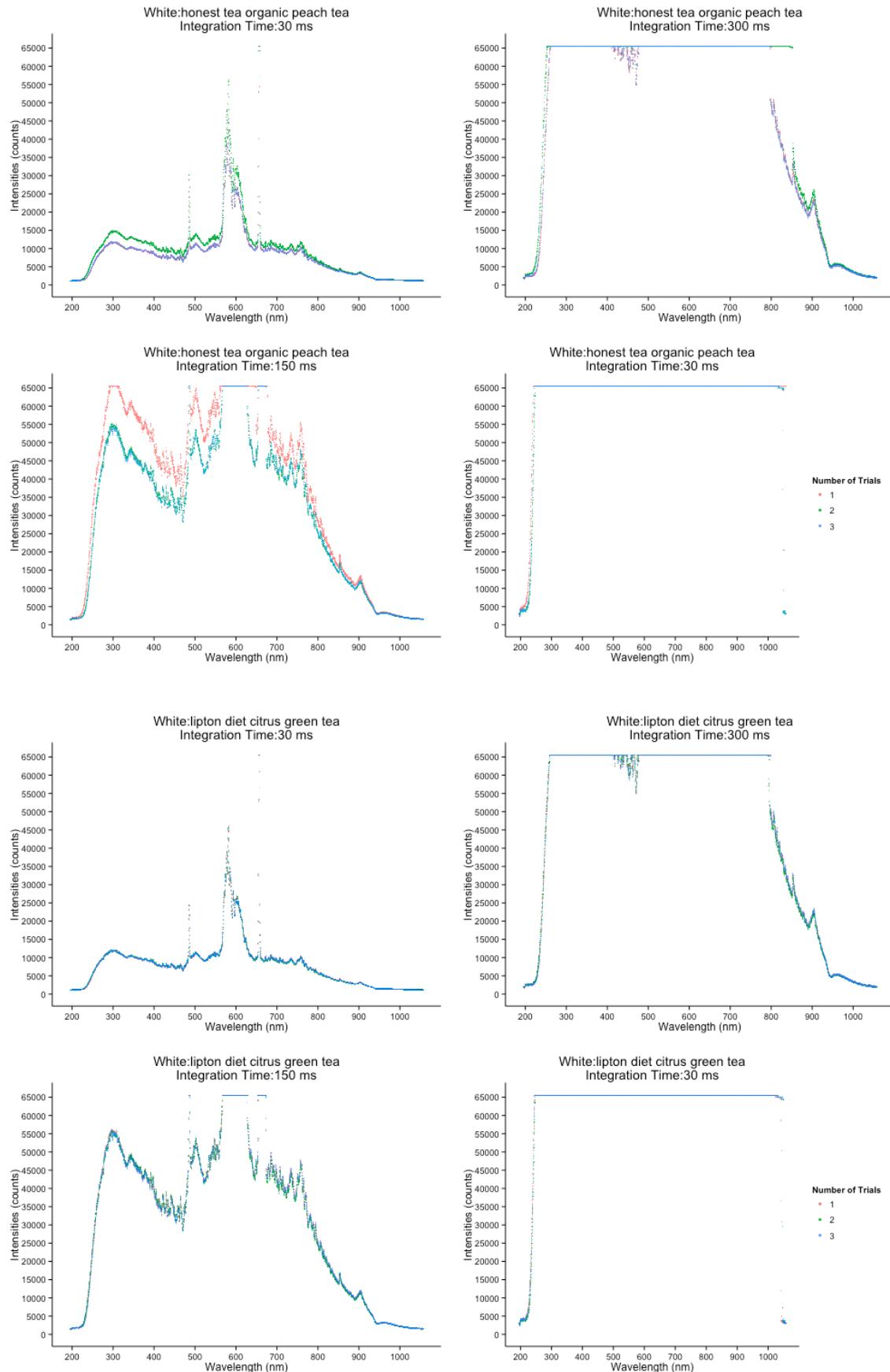


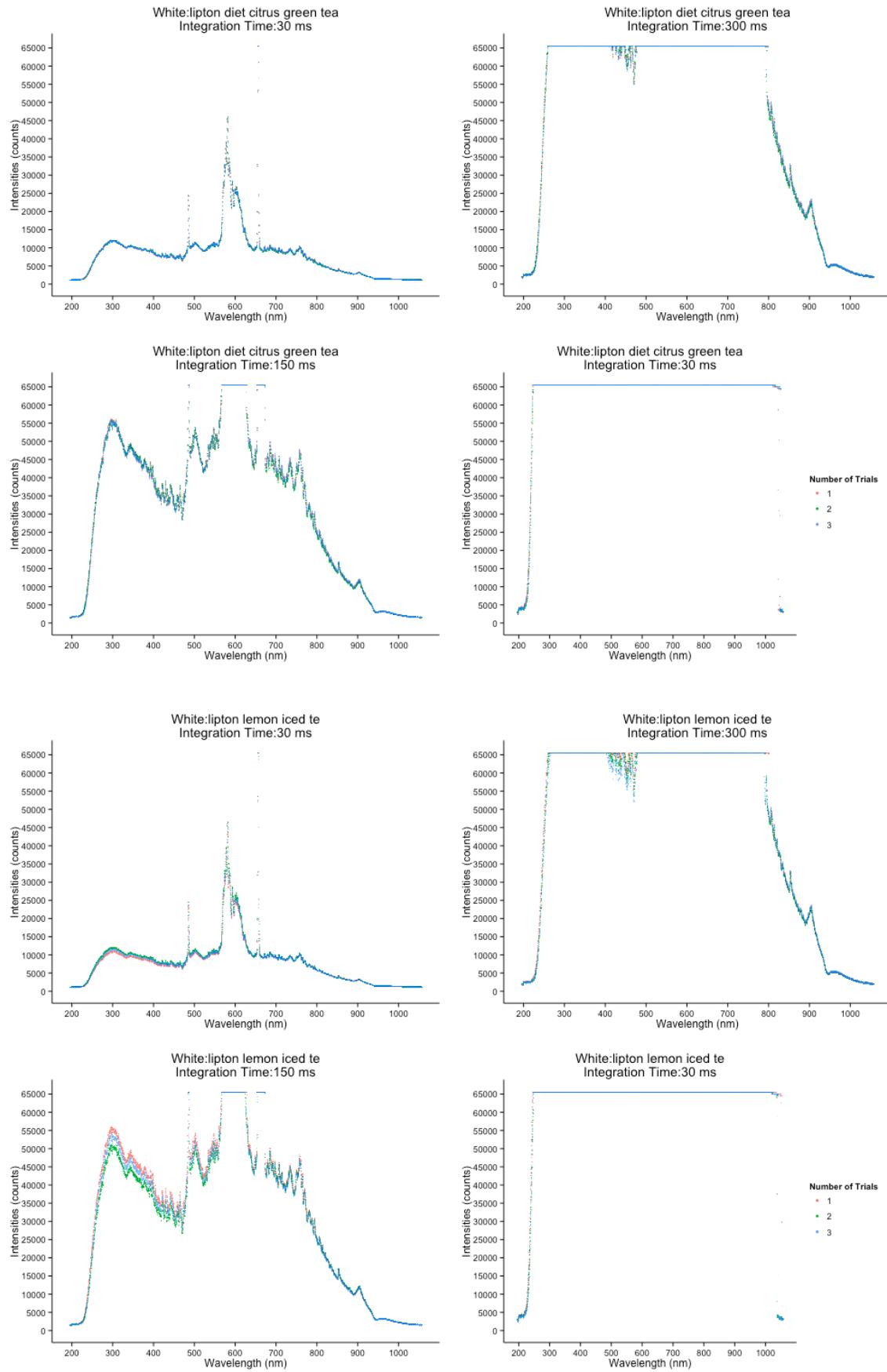


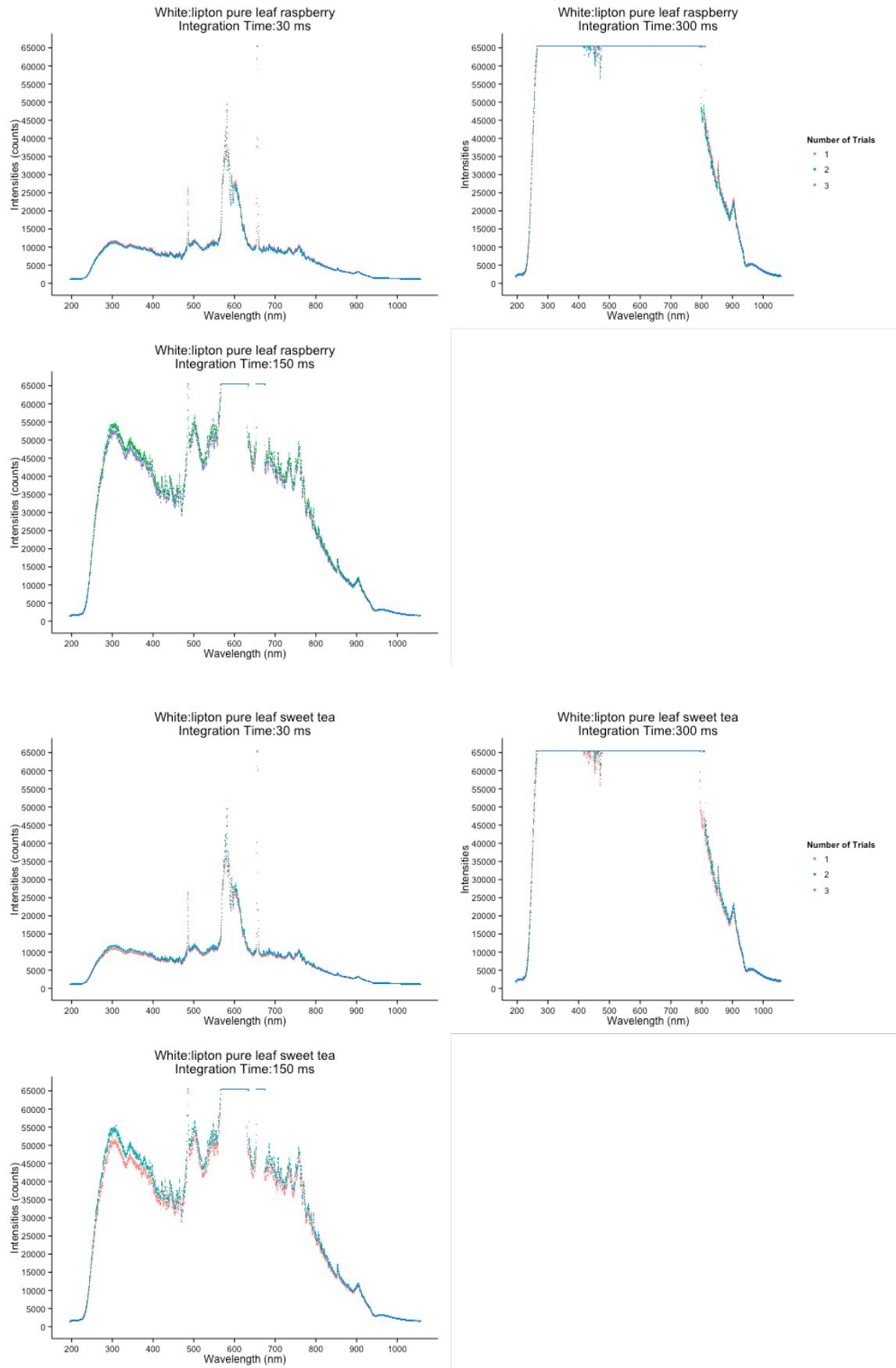


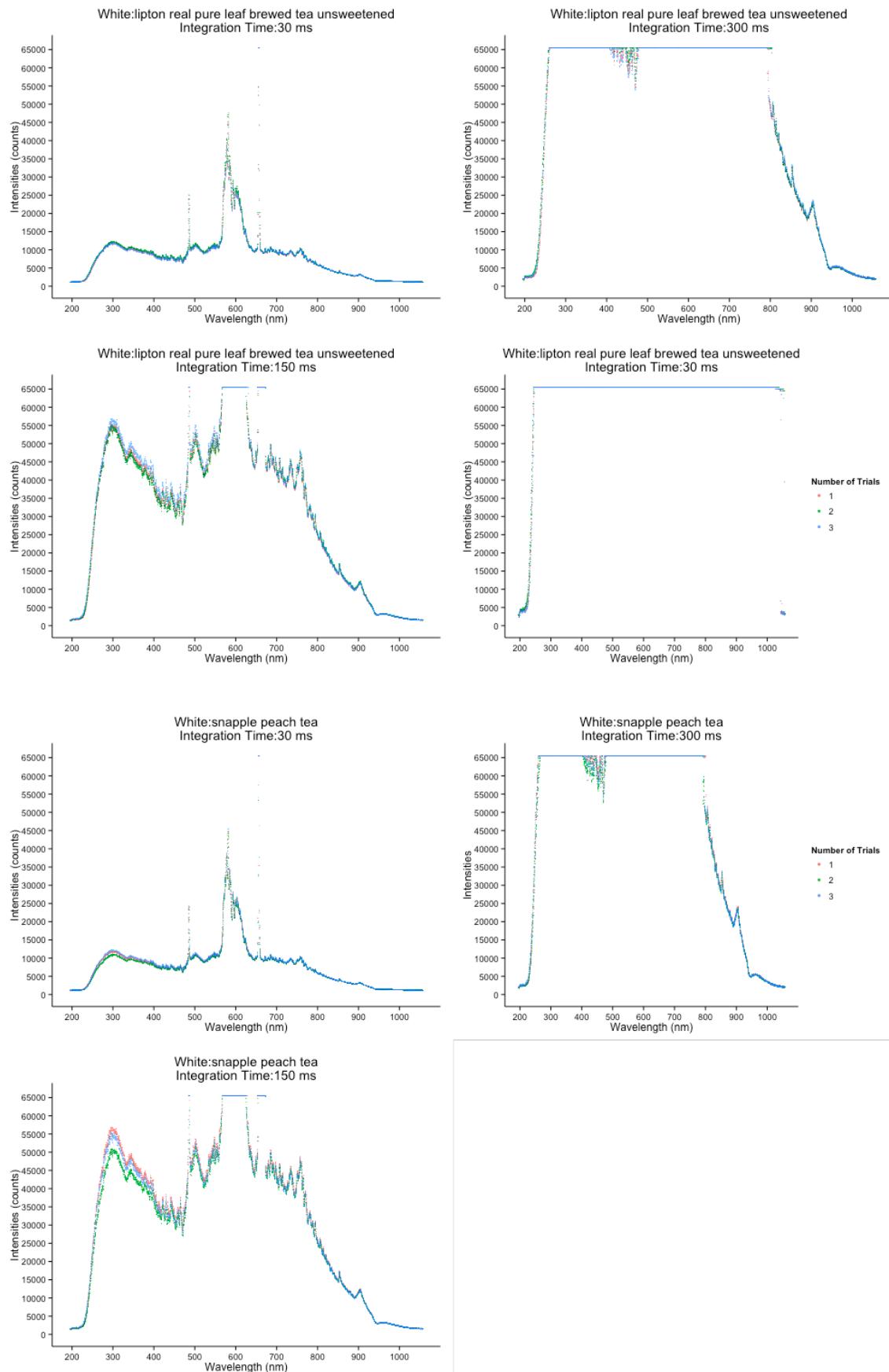
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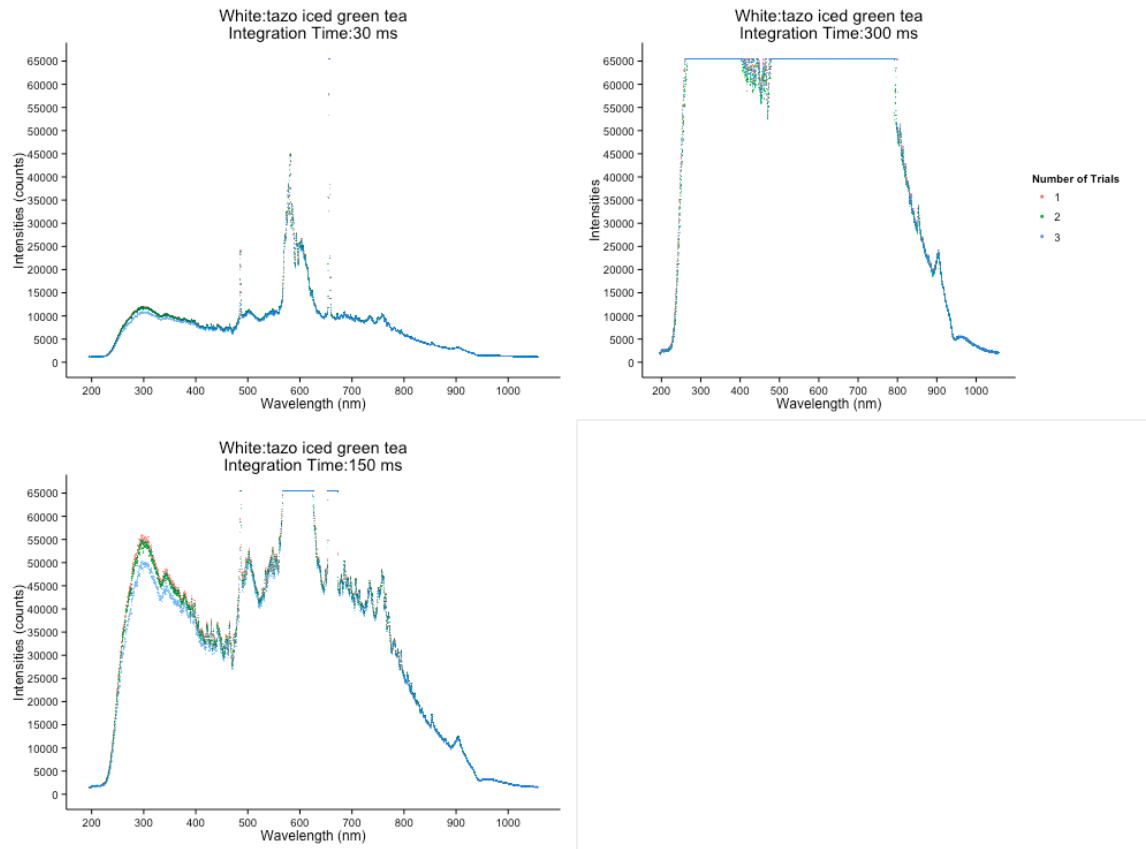




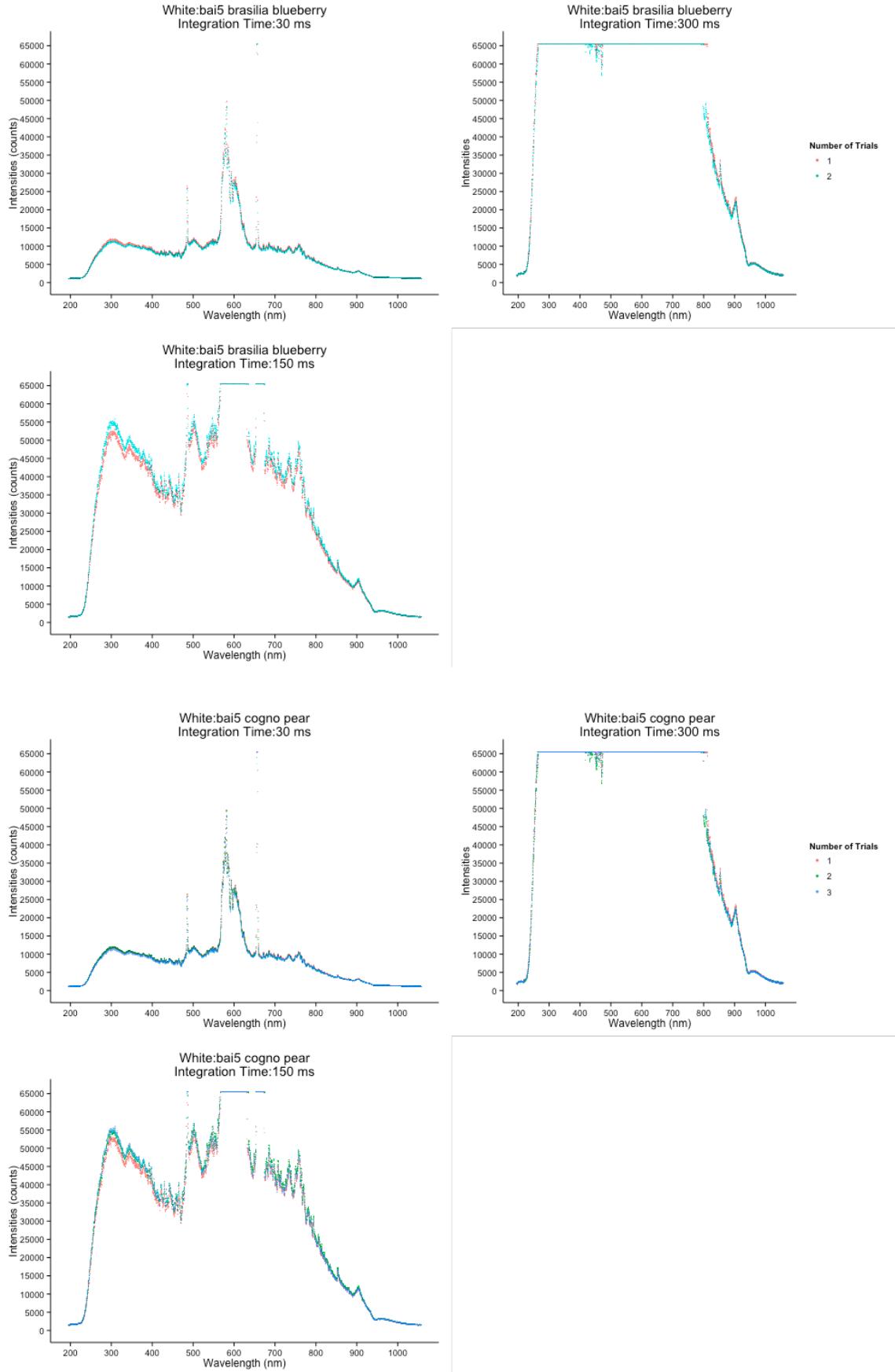


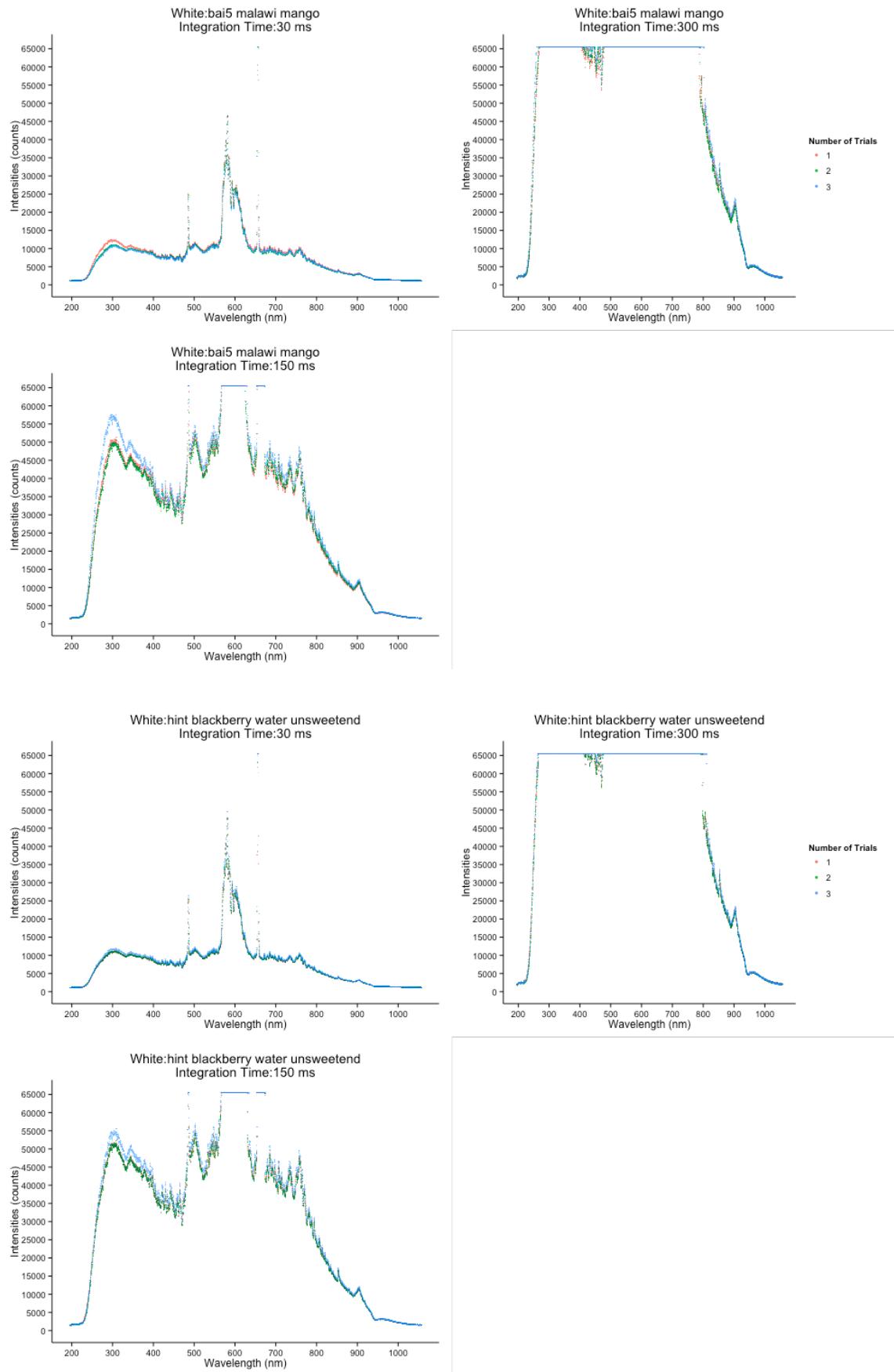


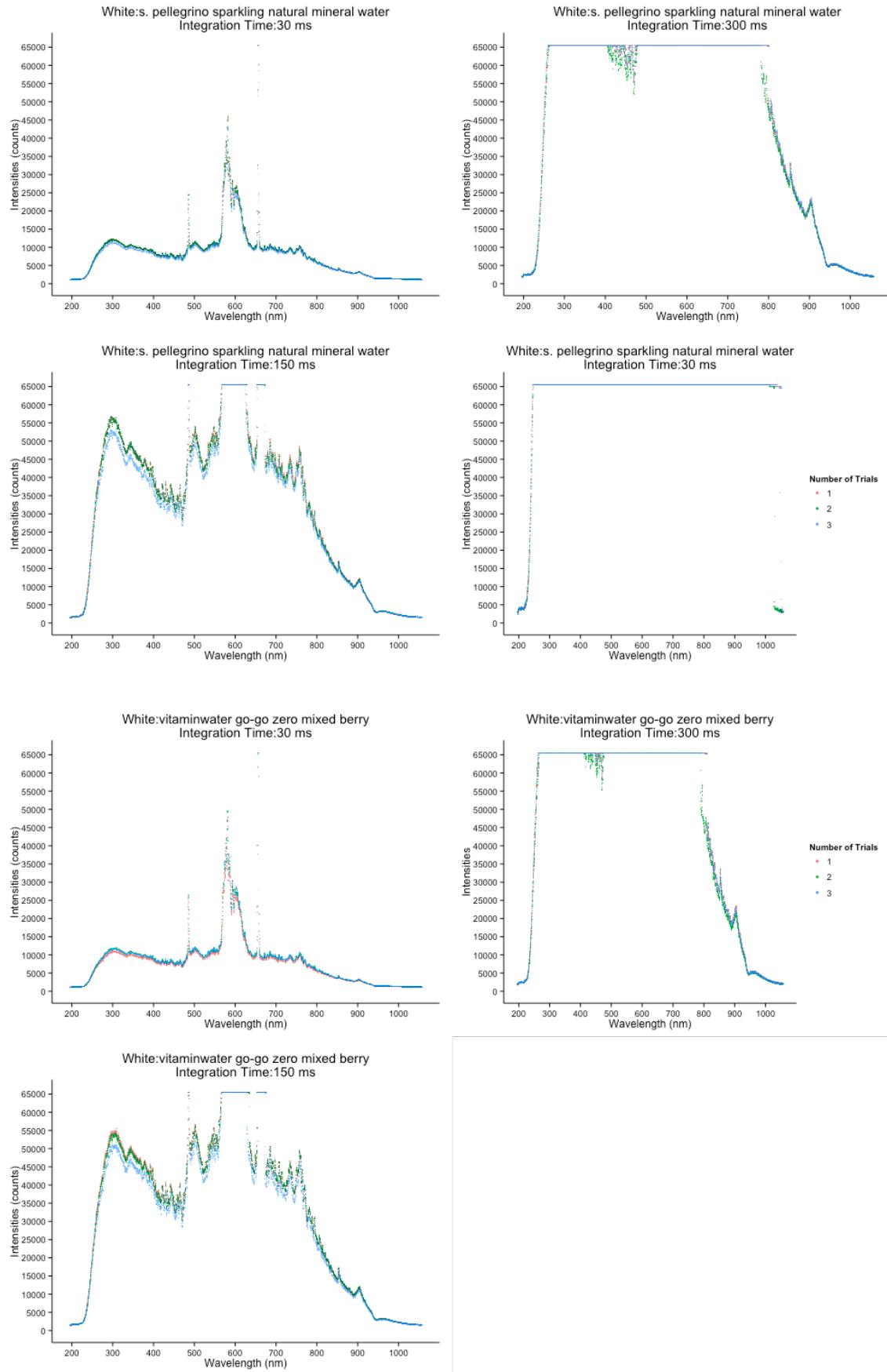


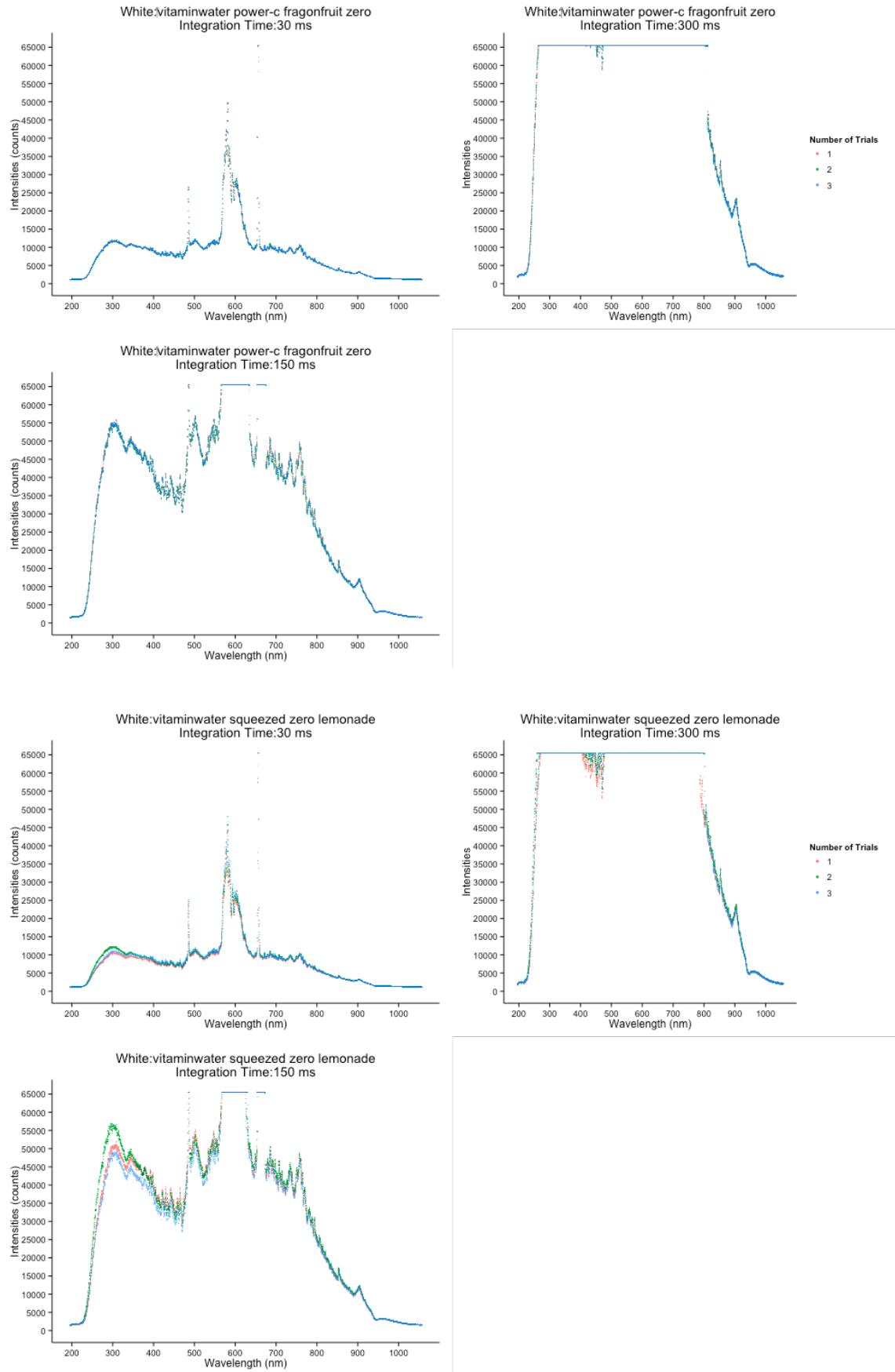


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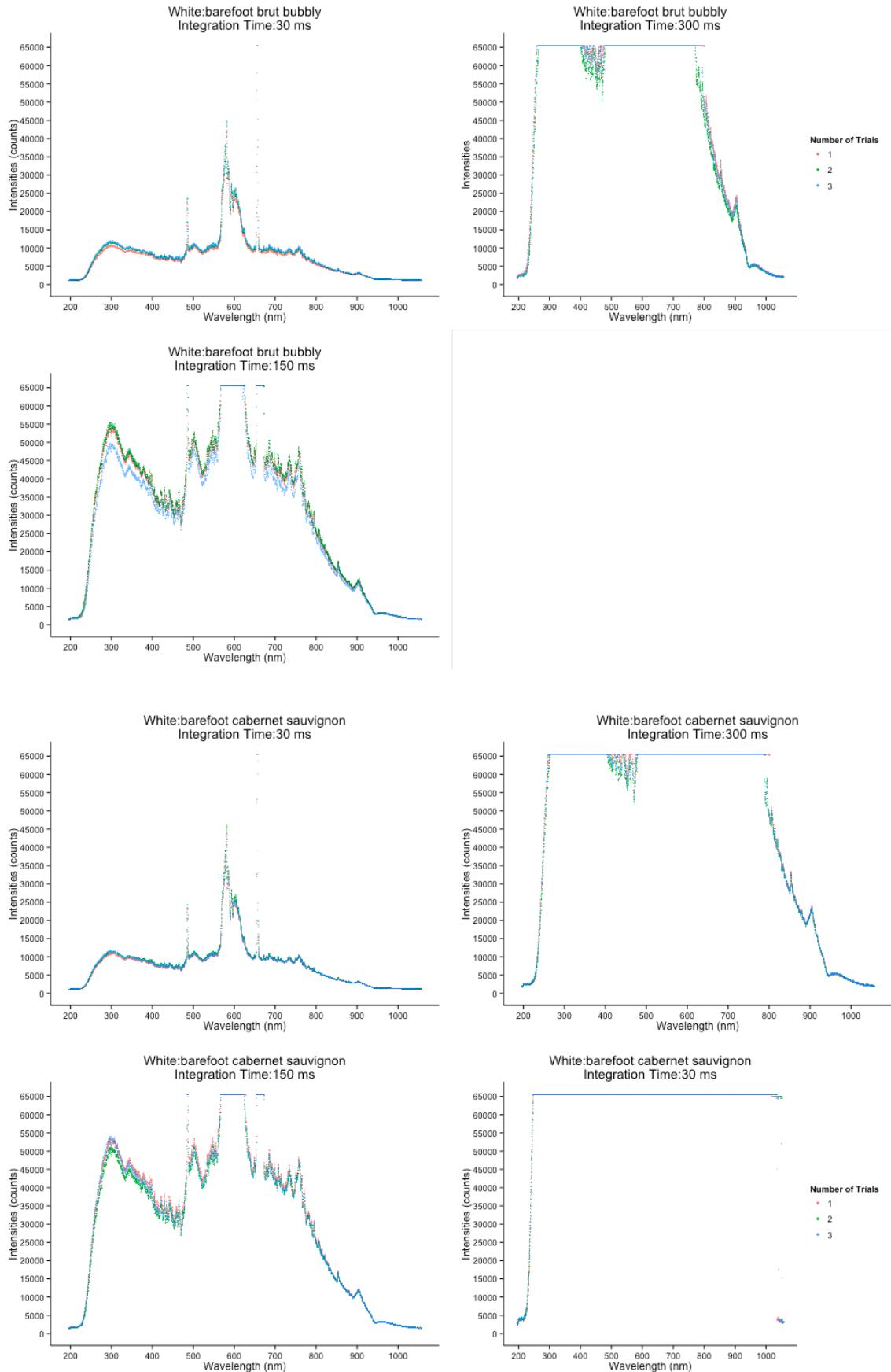


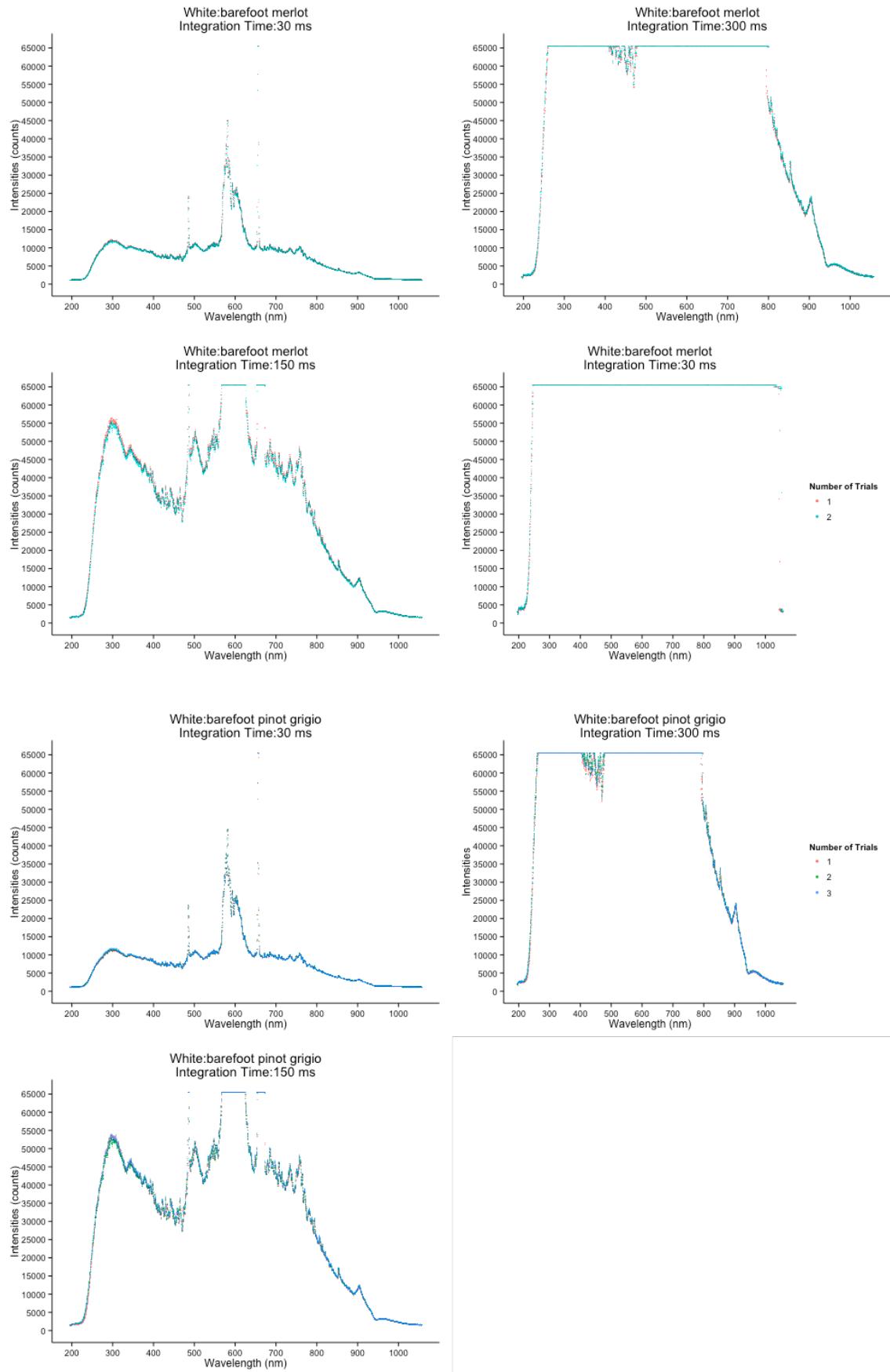


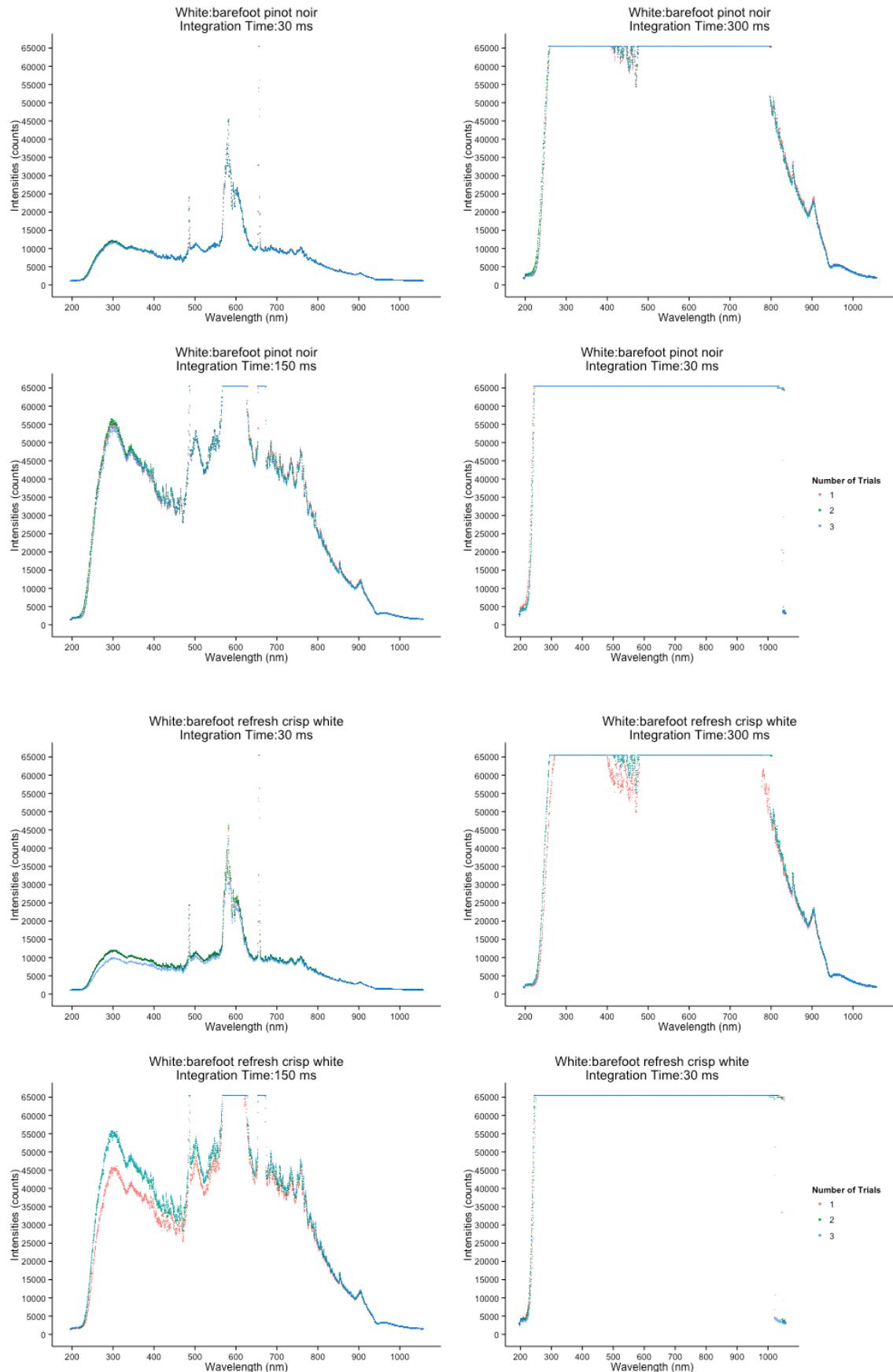


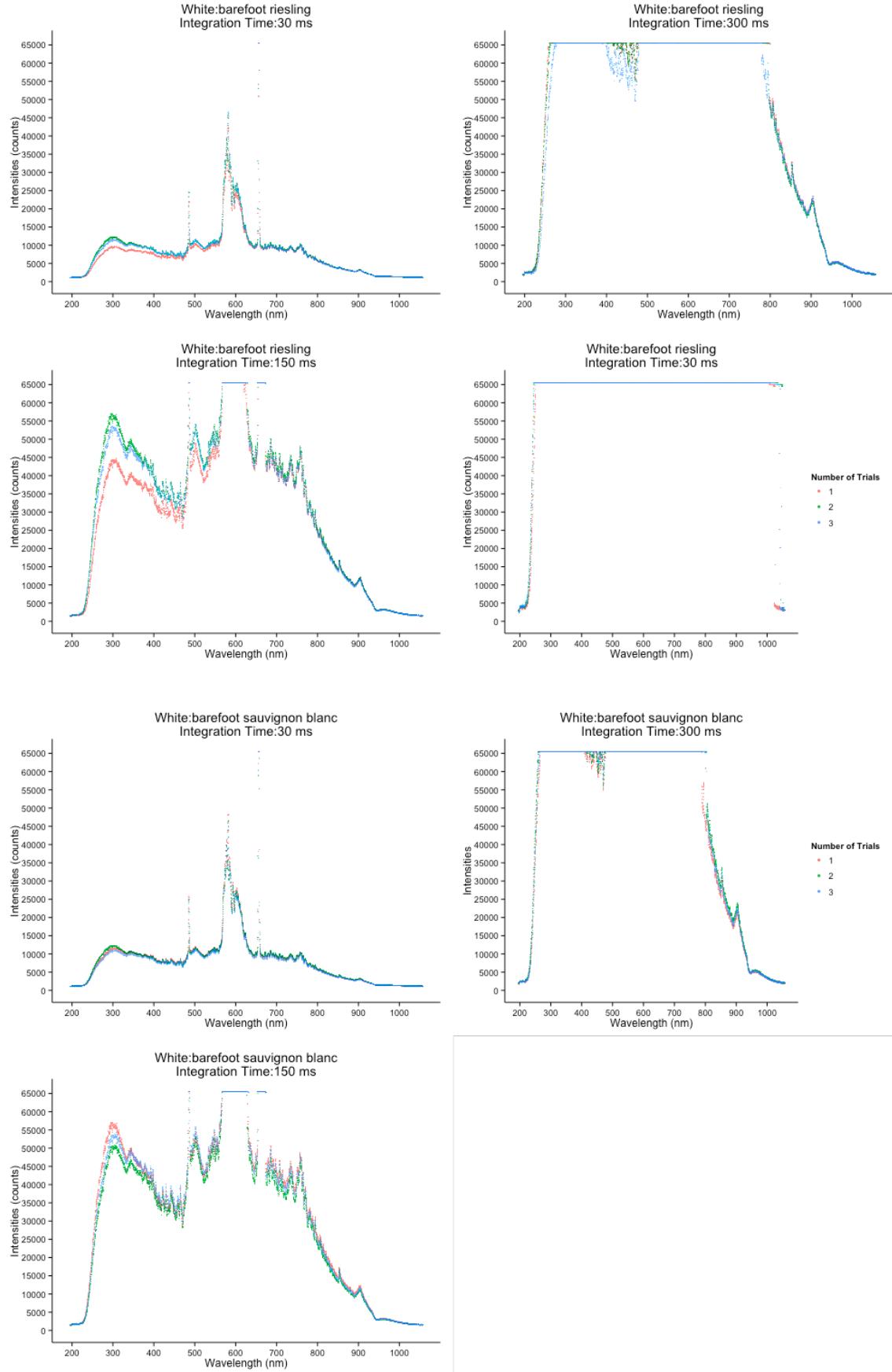


Wine



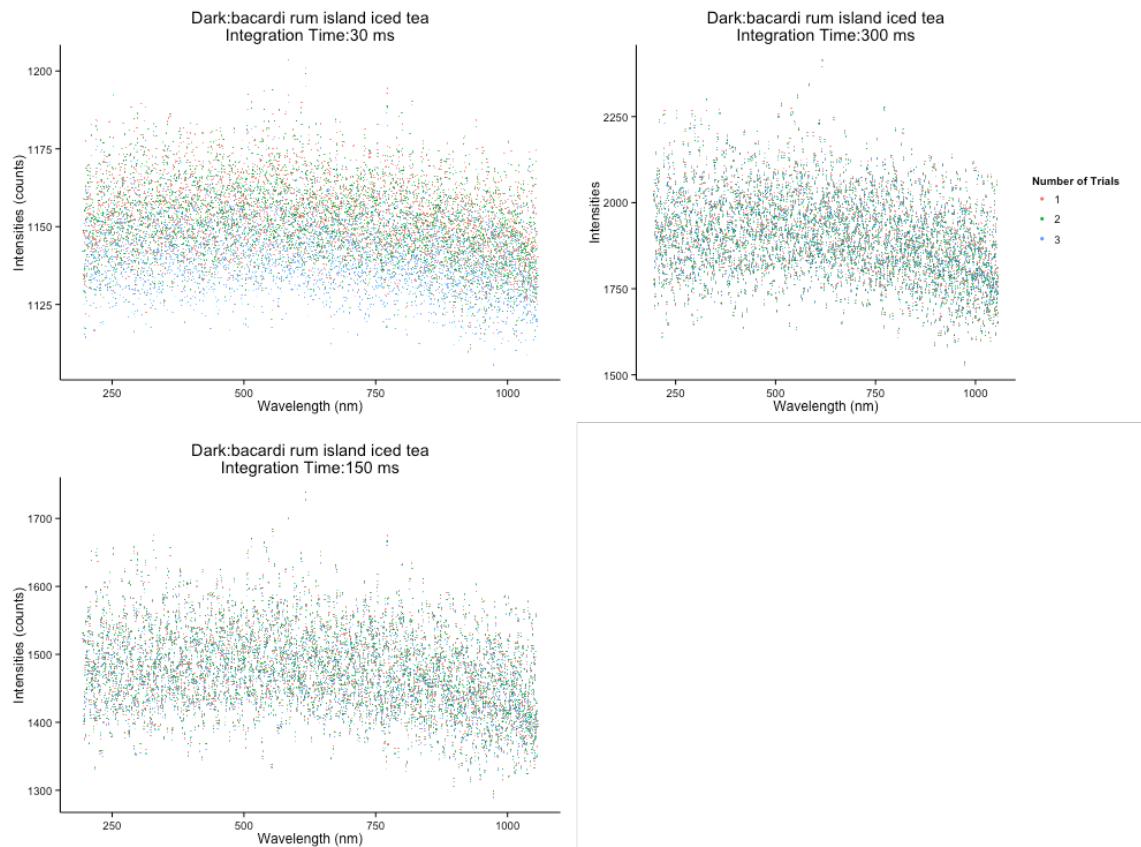


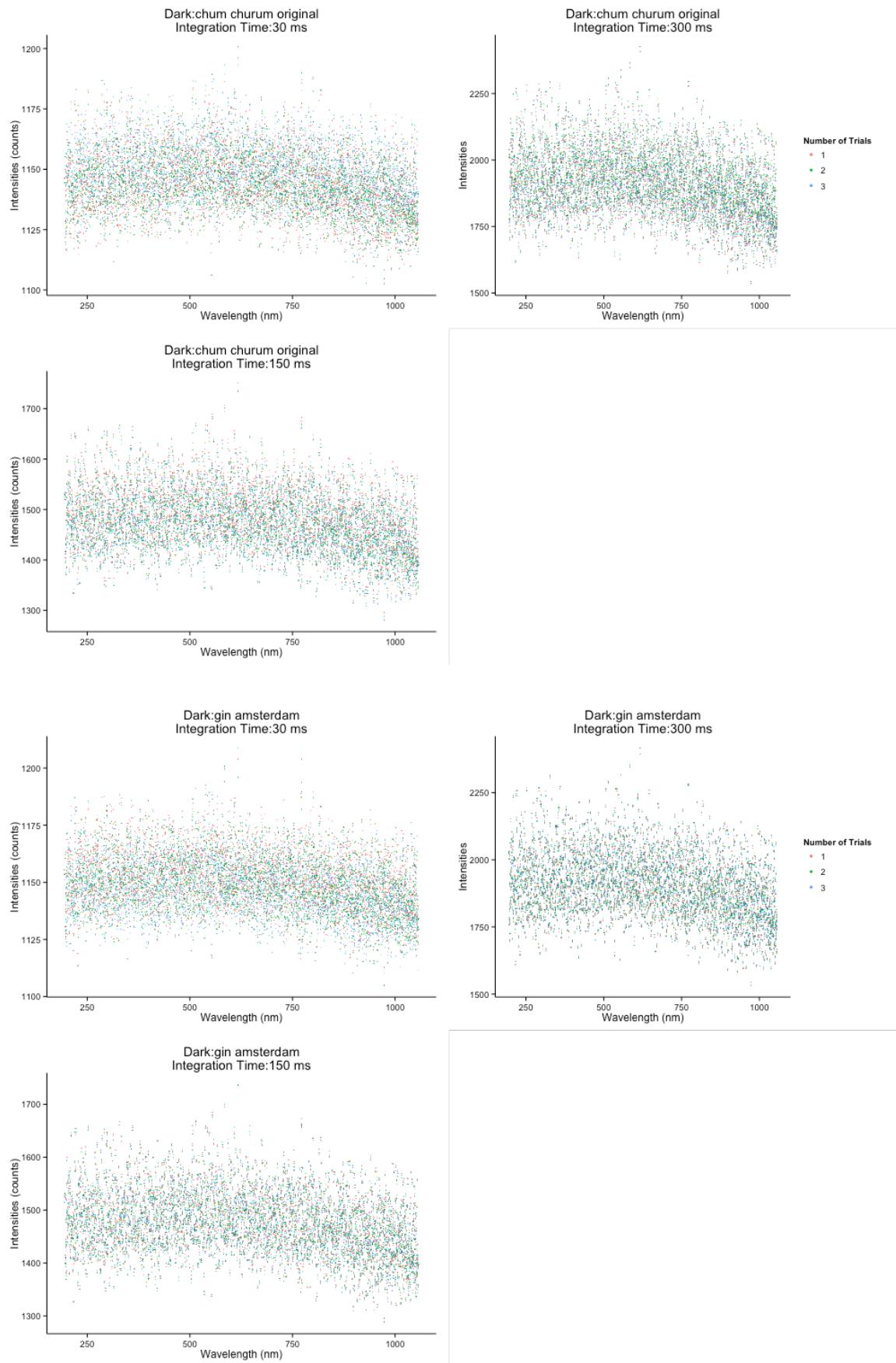


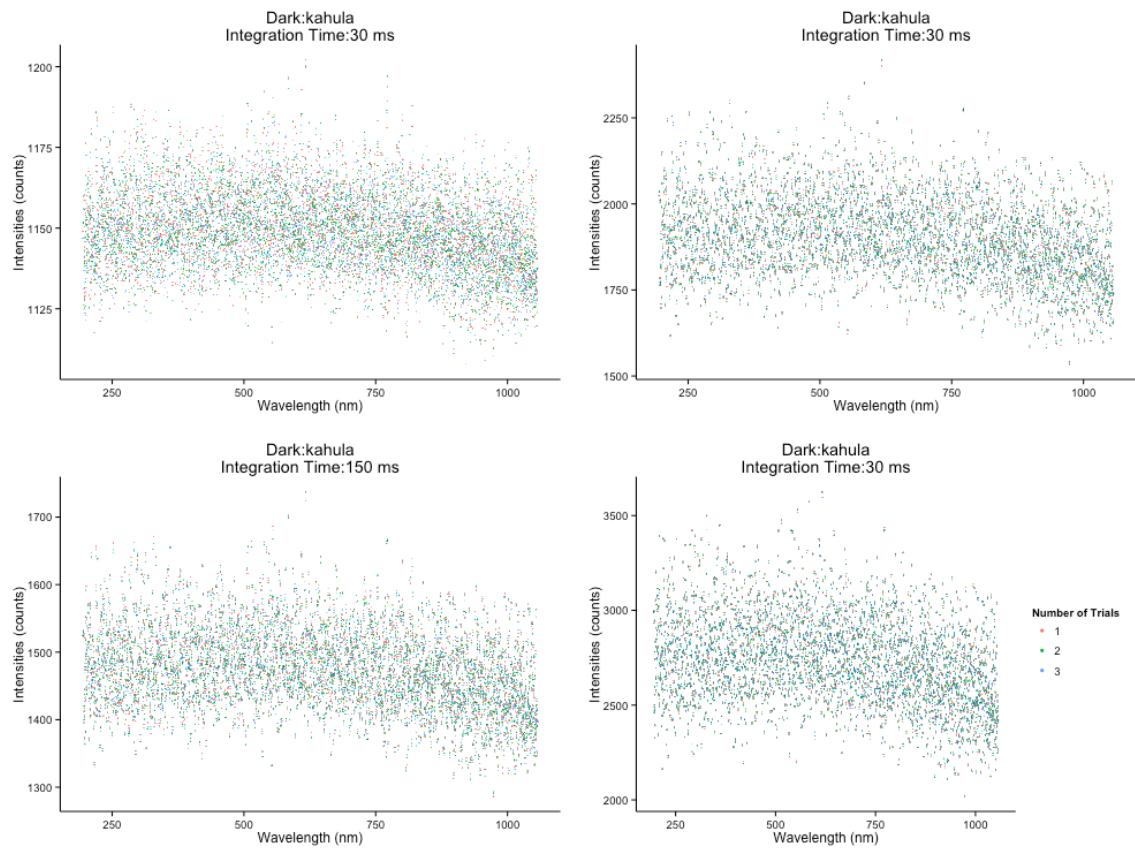


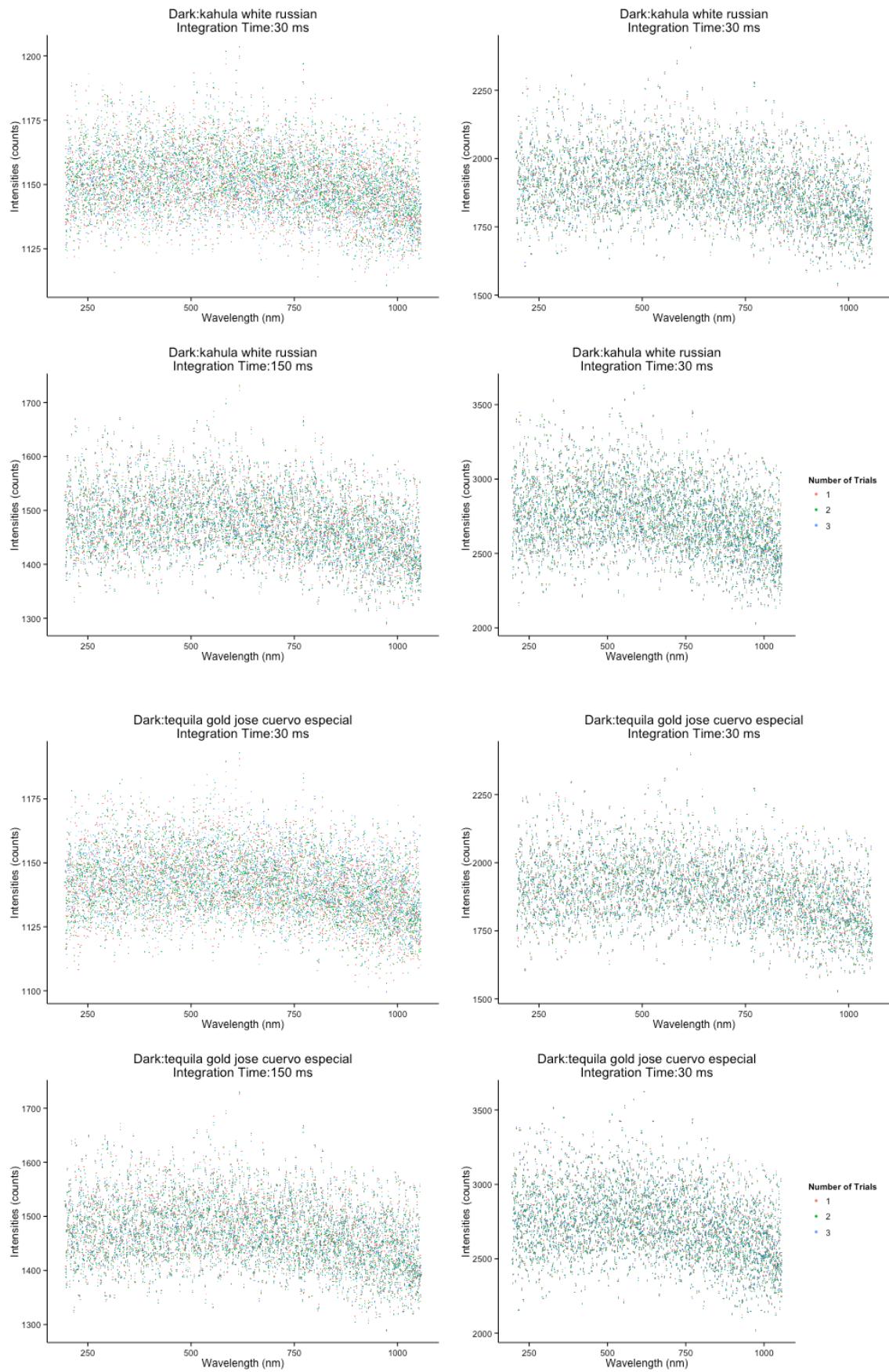
Appendix D-Dark

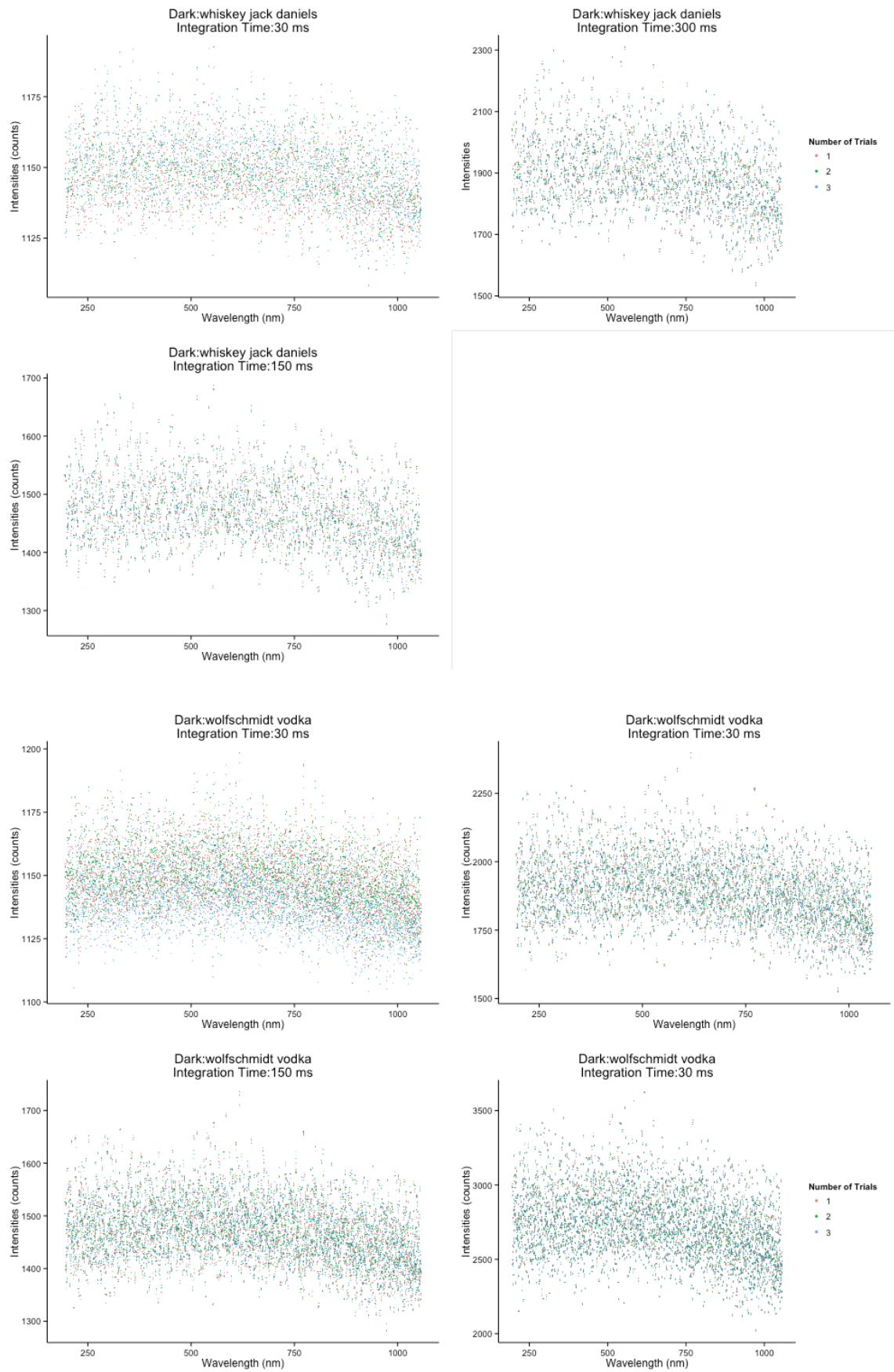
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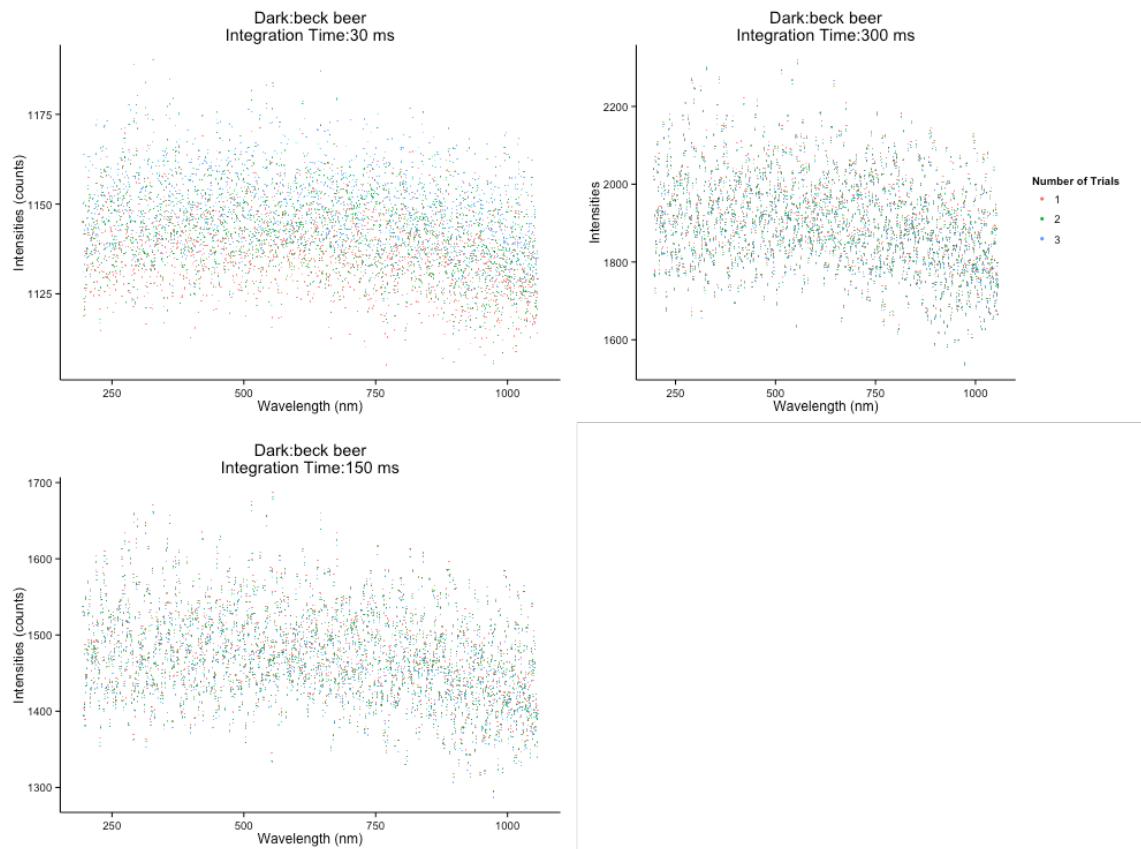


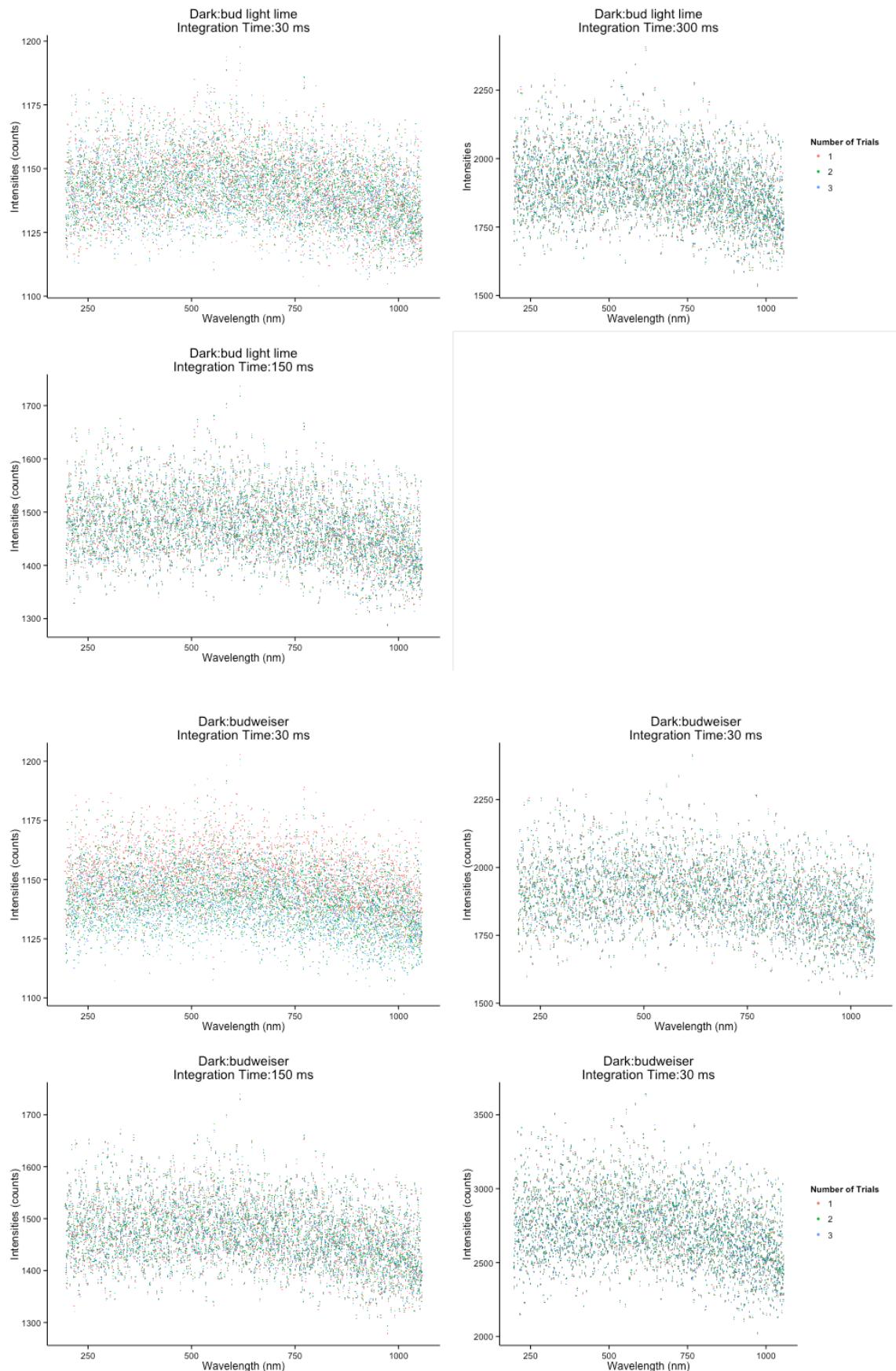


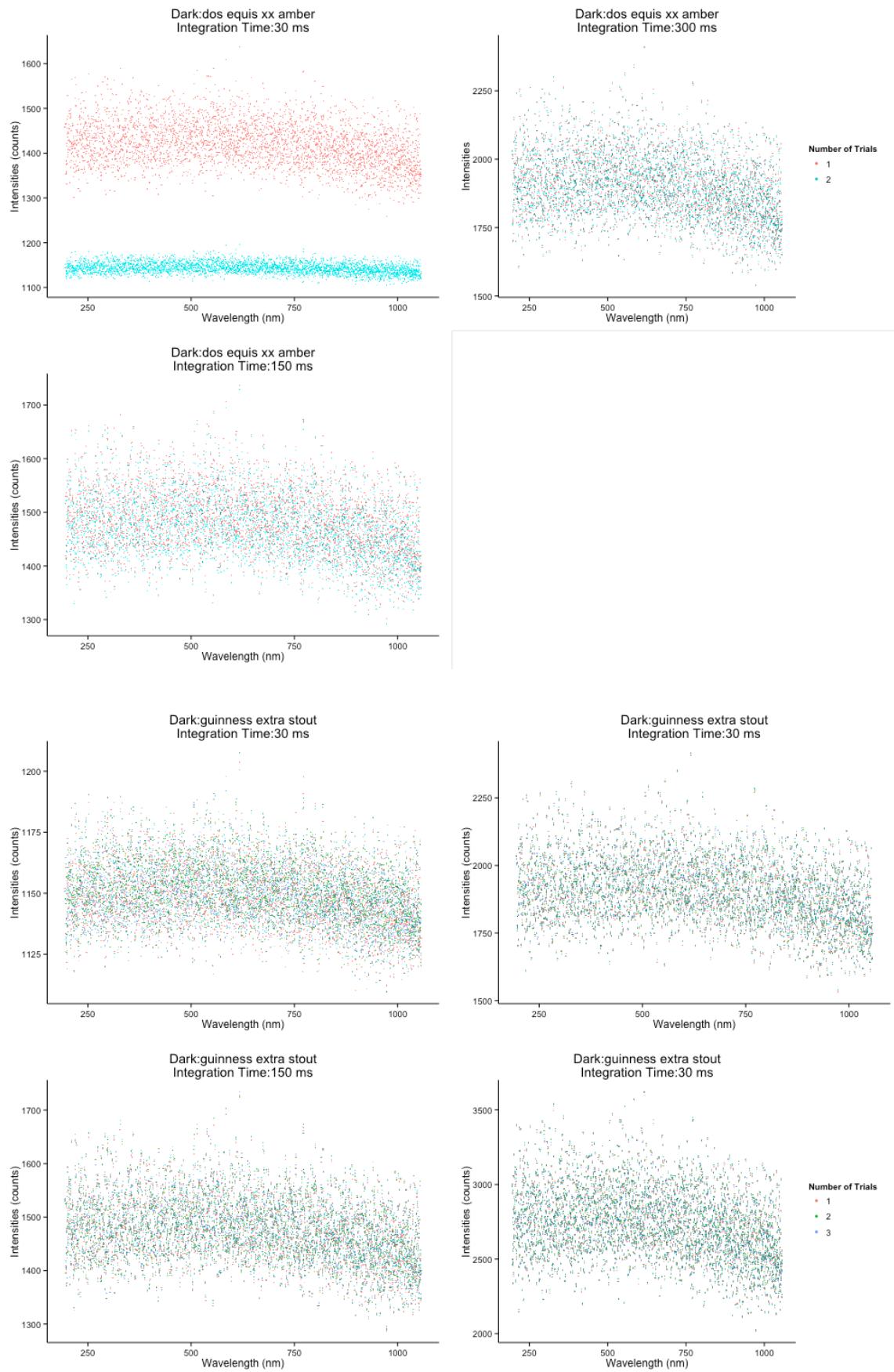


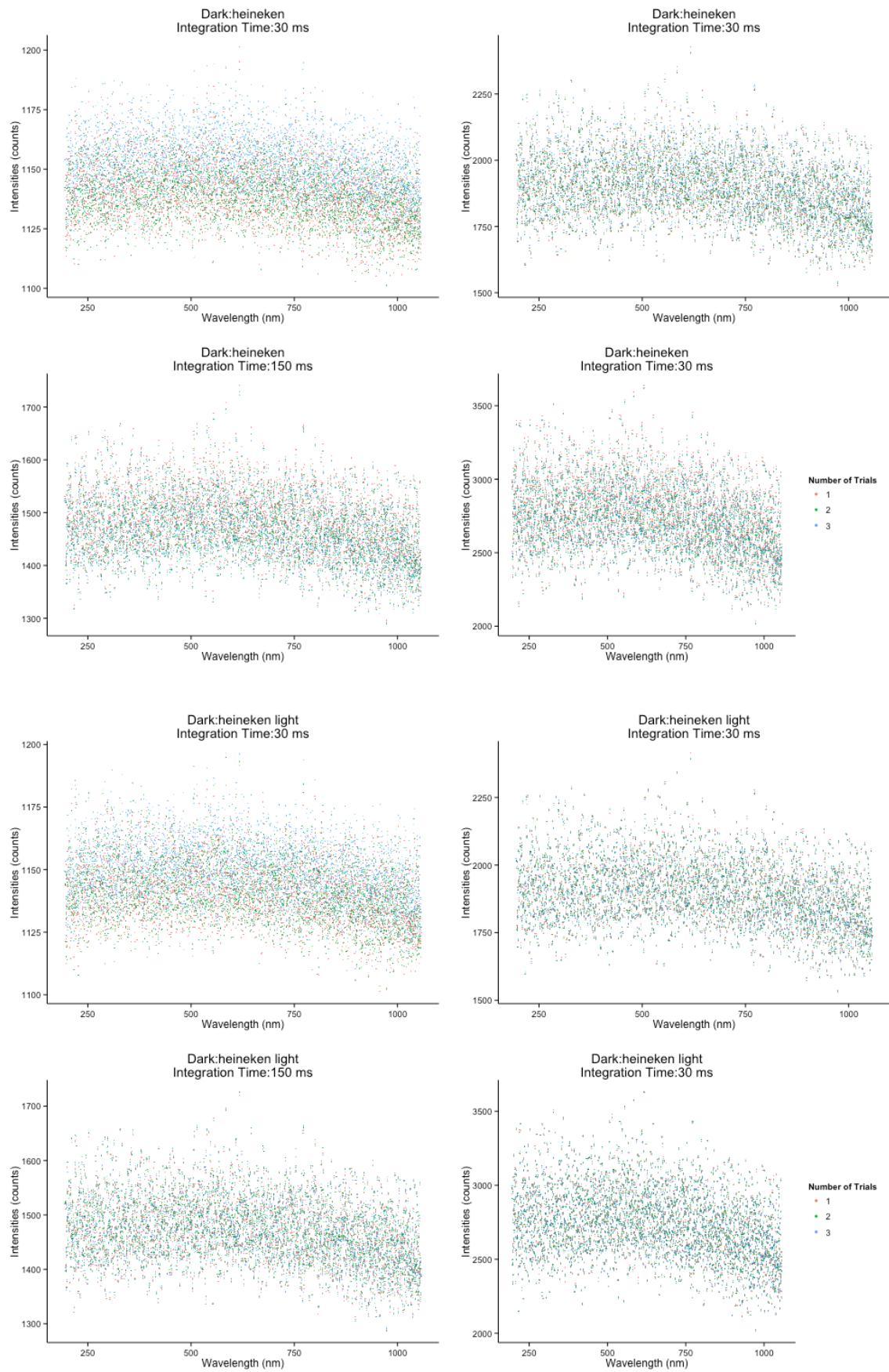


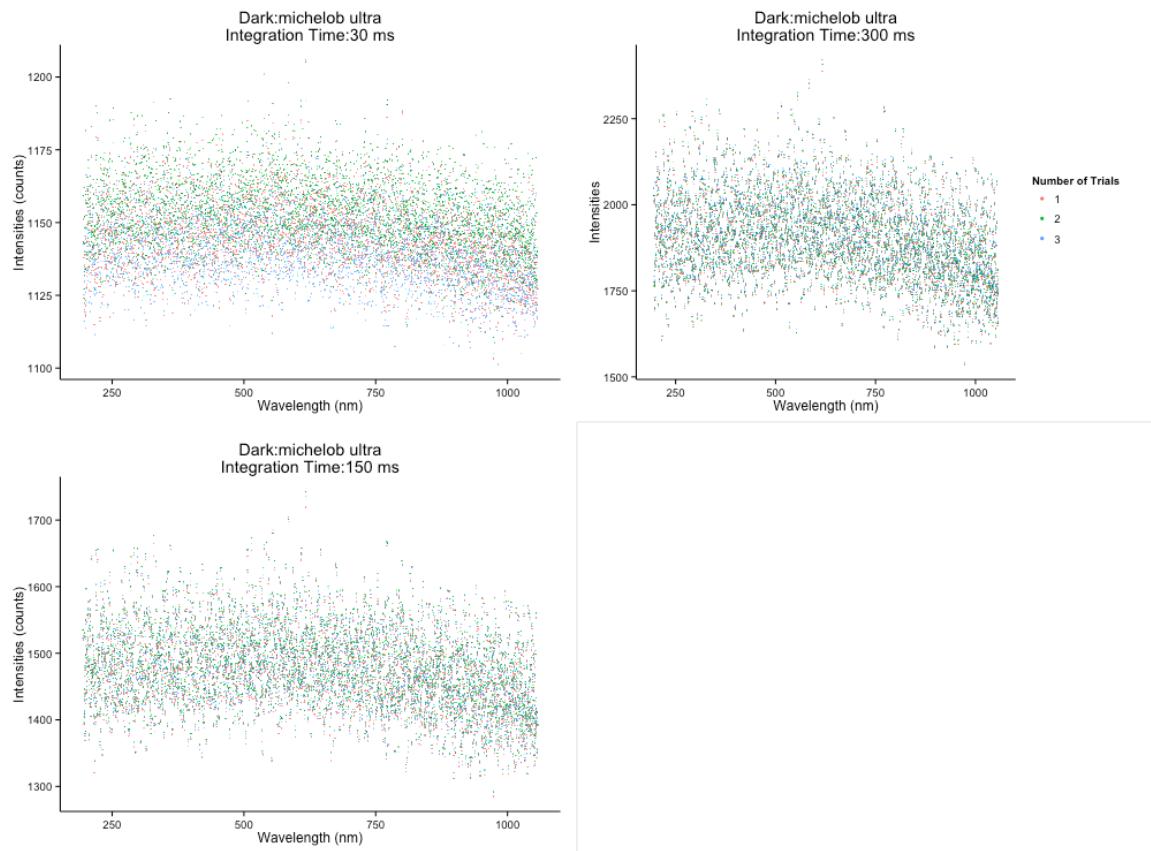
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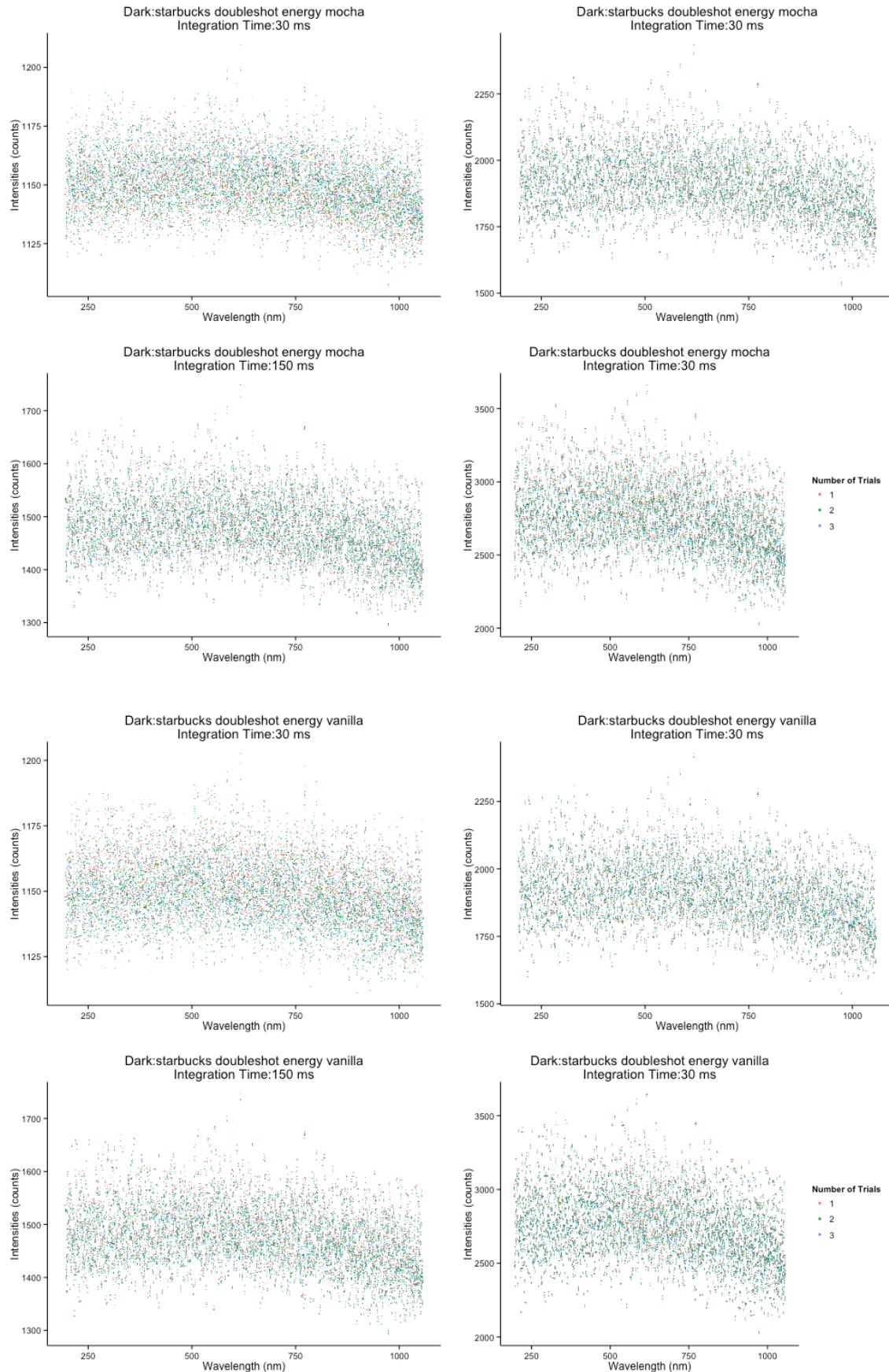


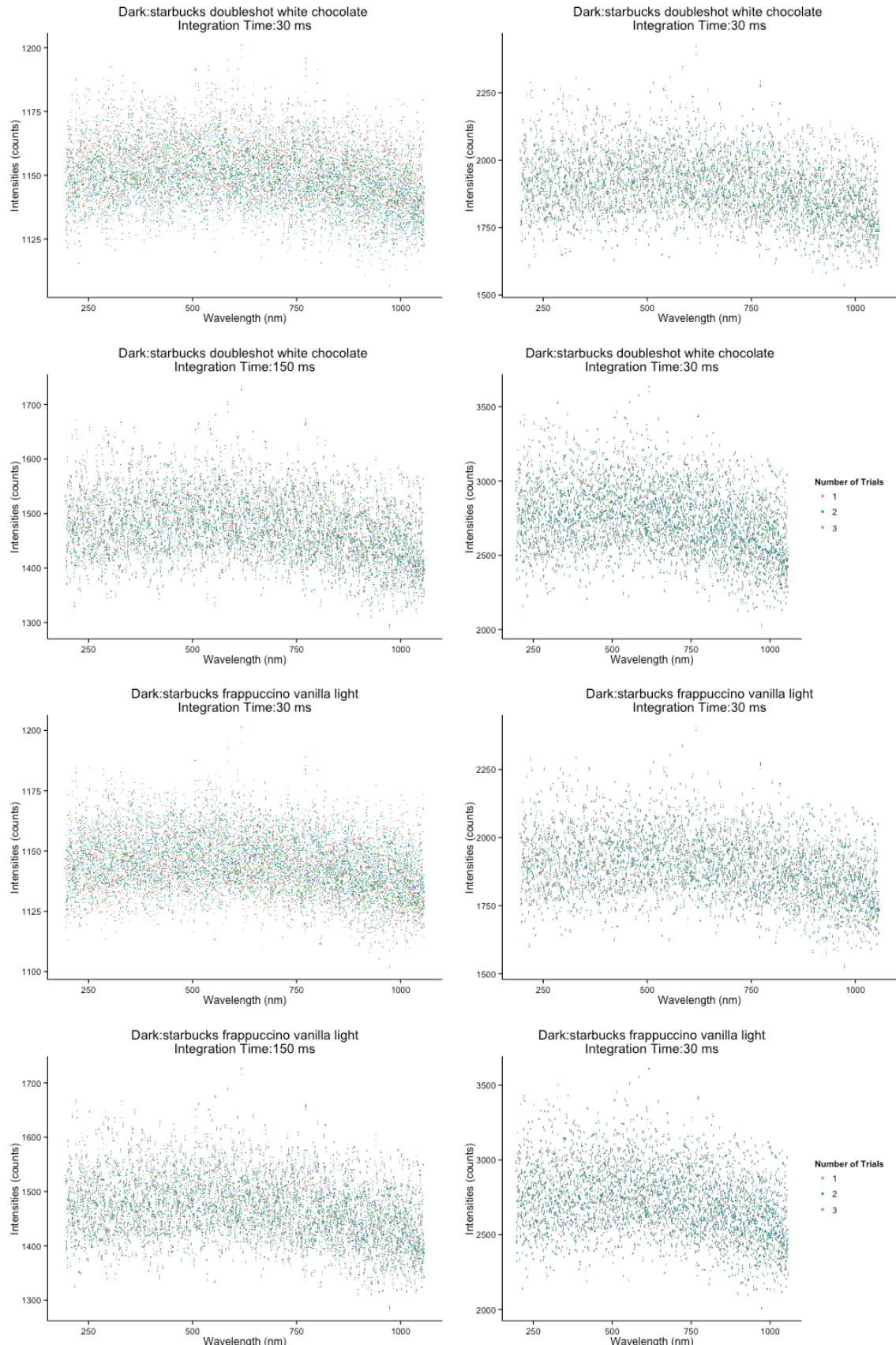


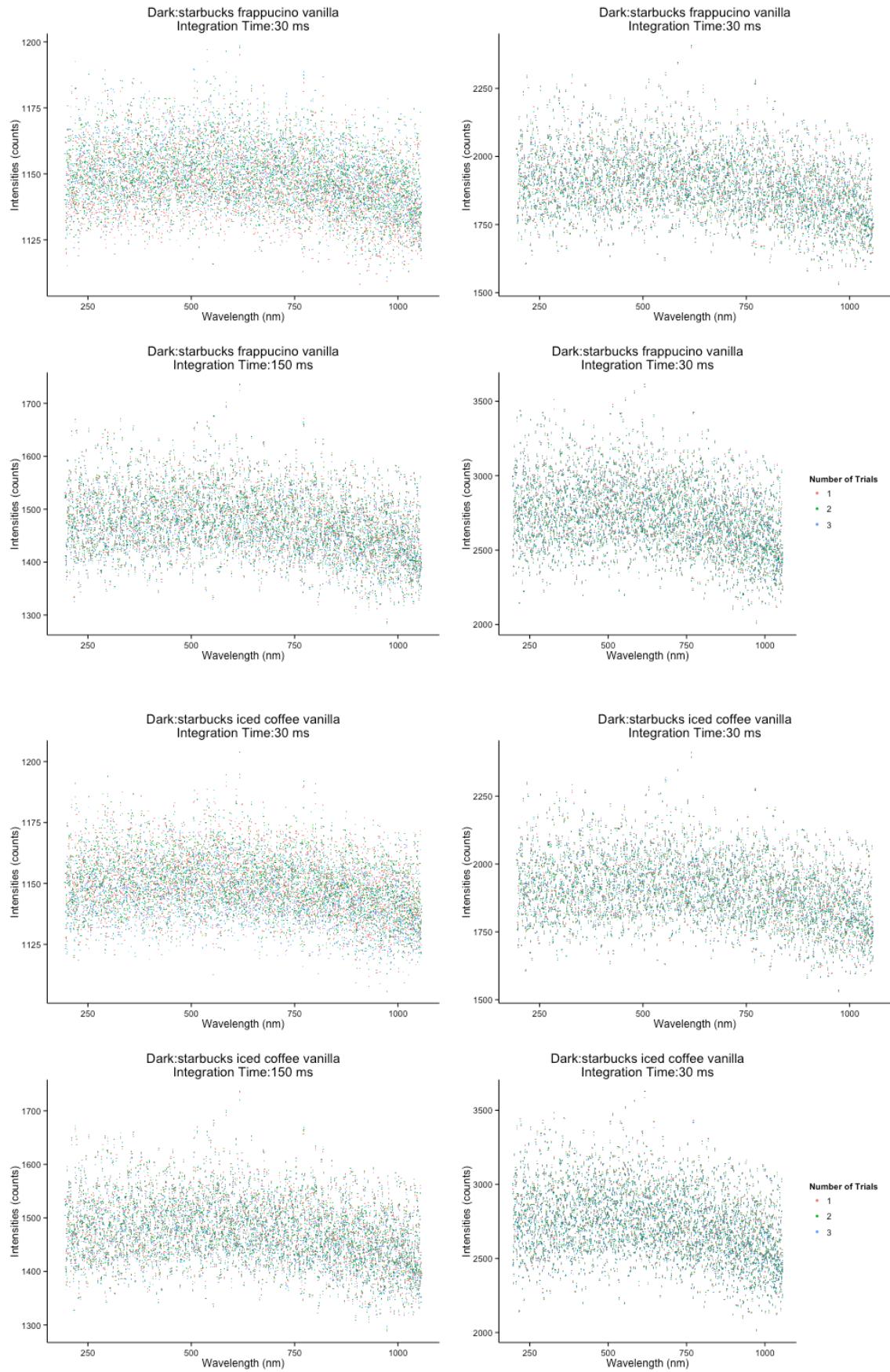


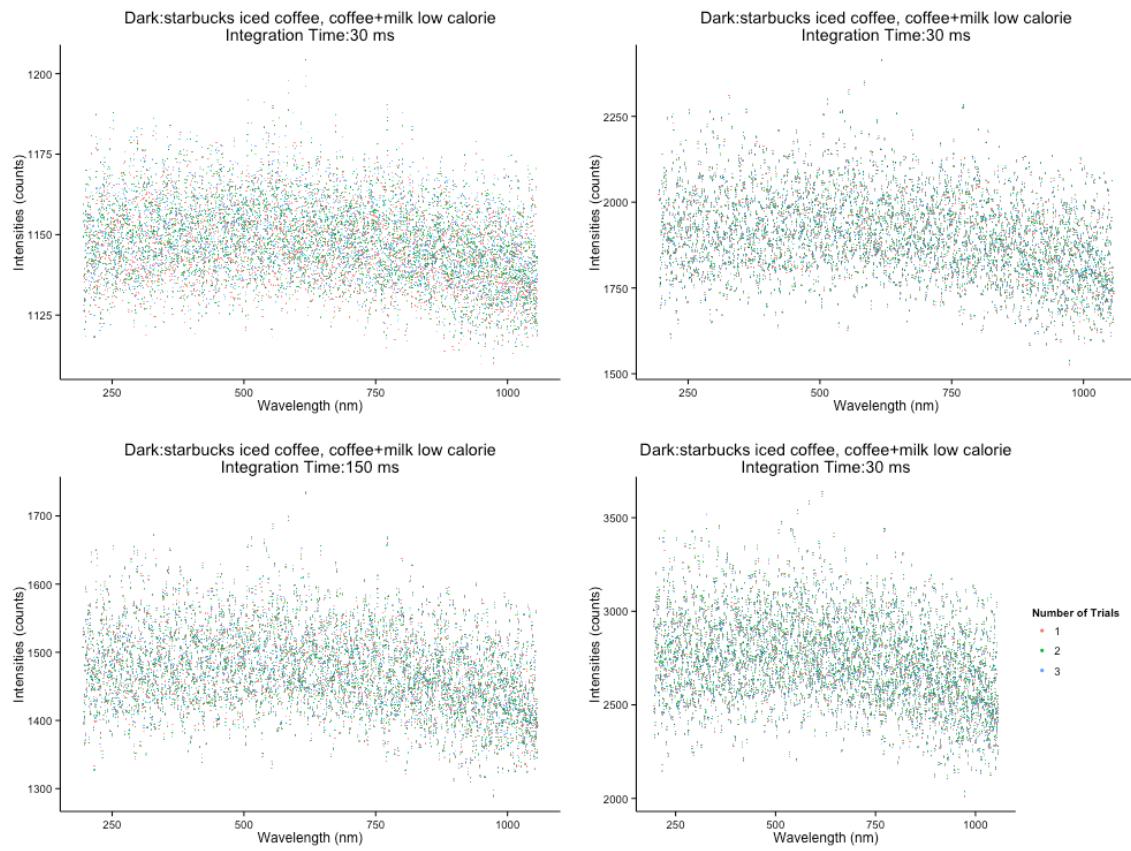


Coffee:

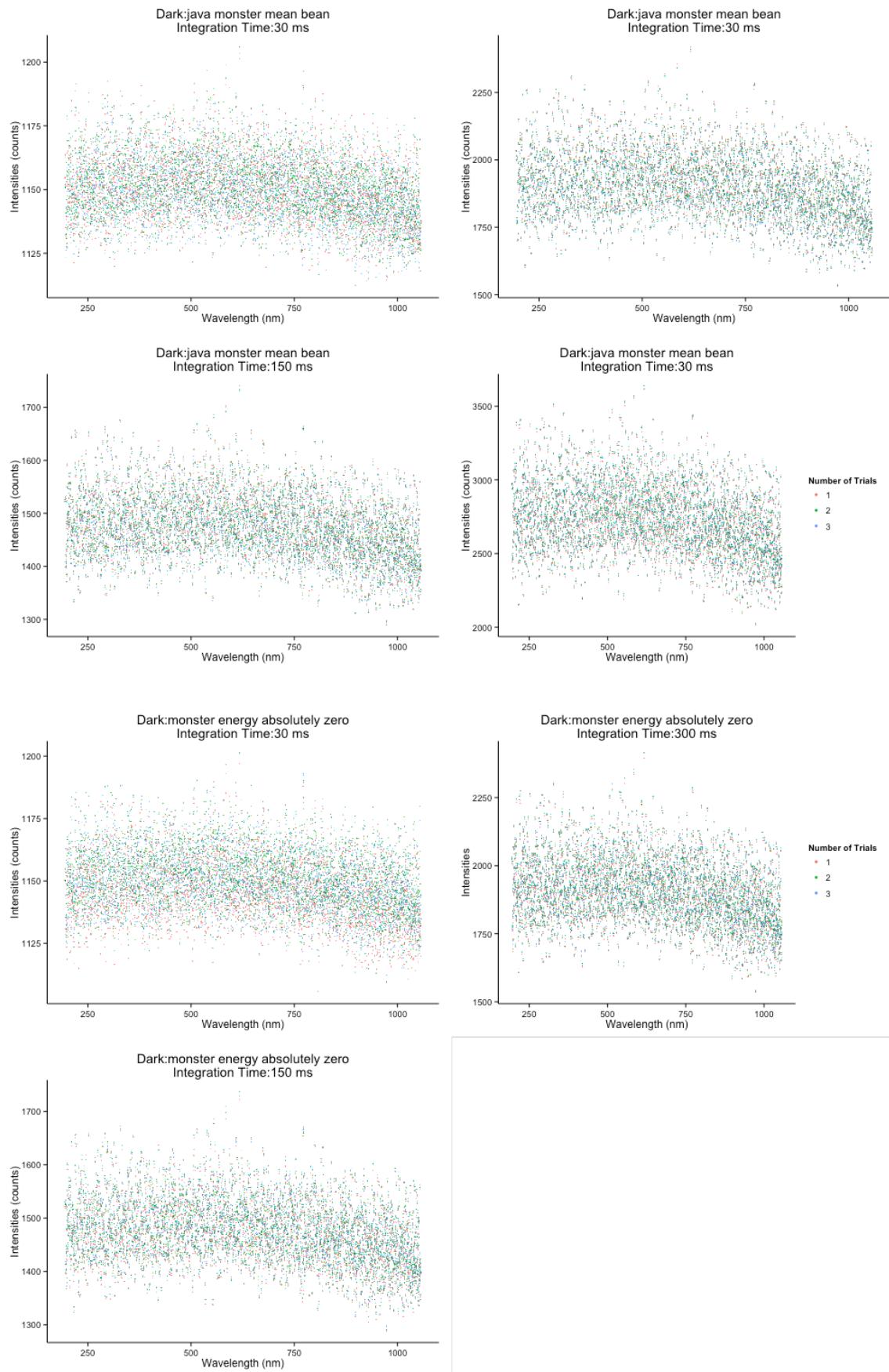


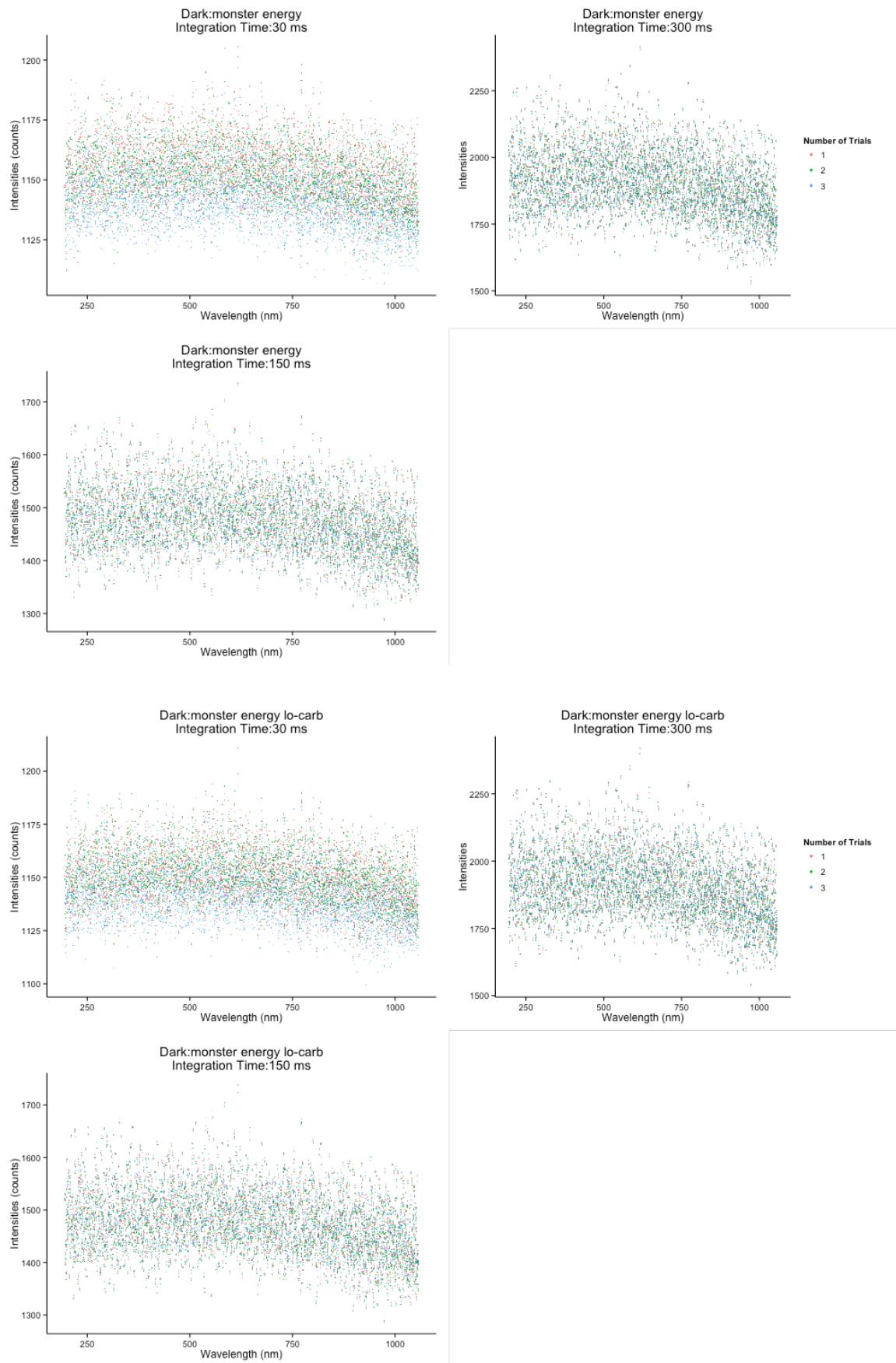


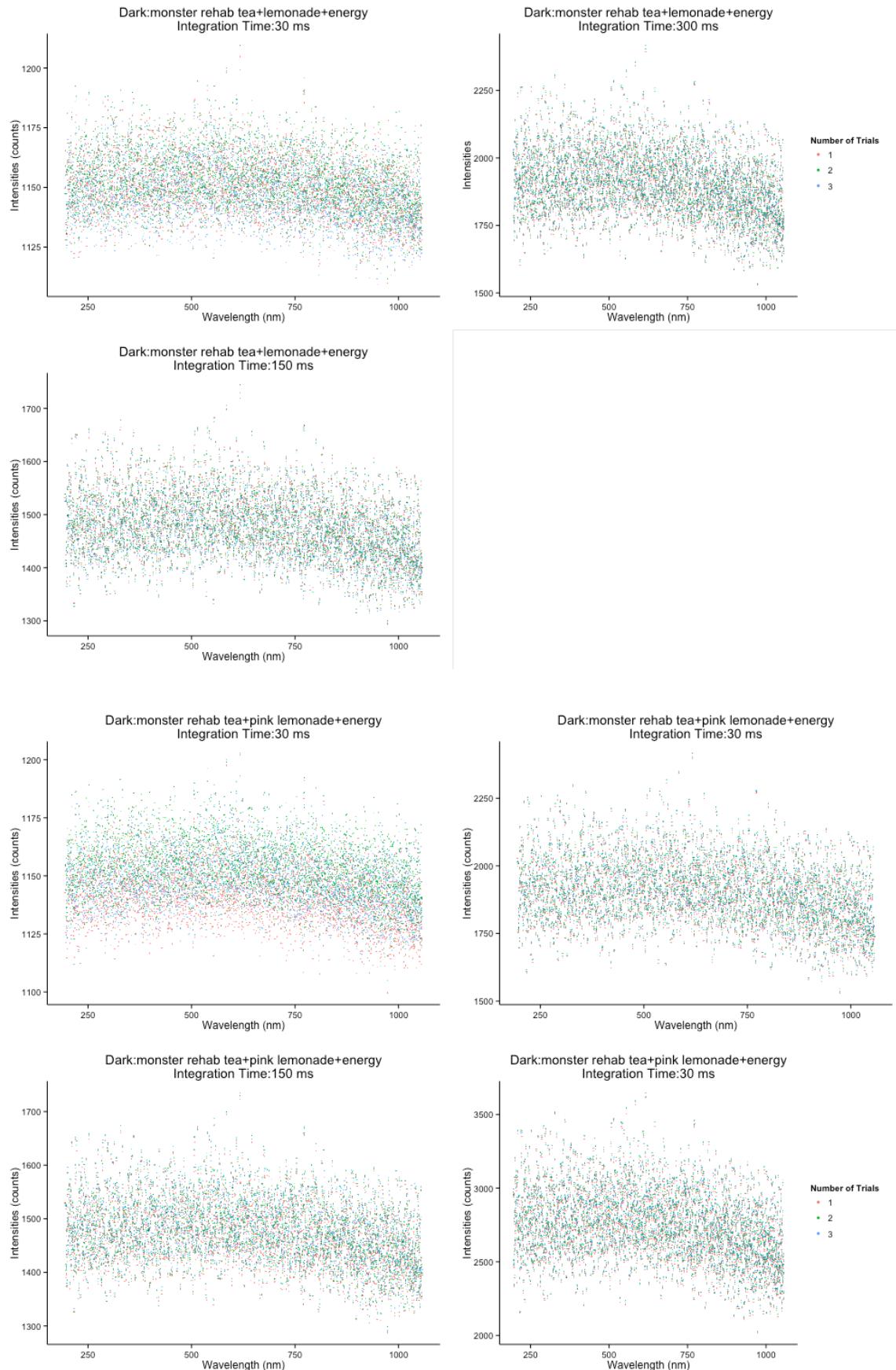


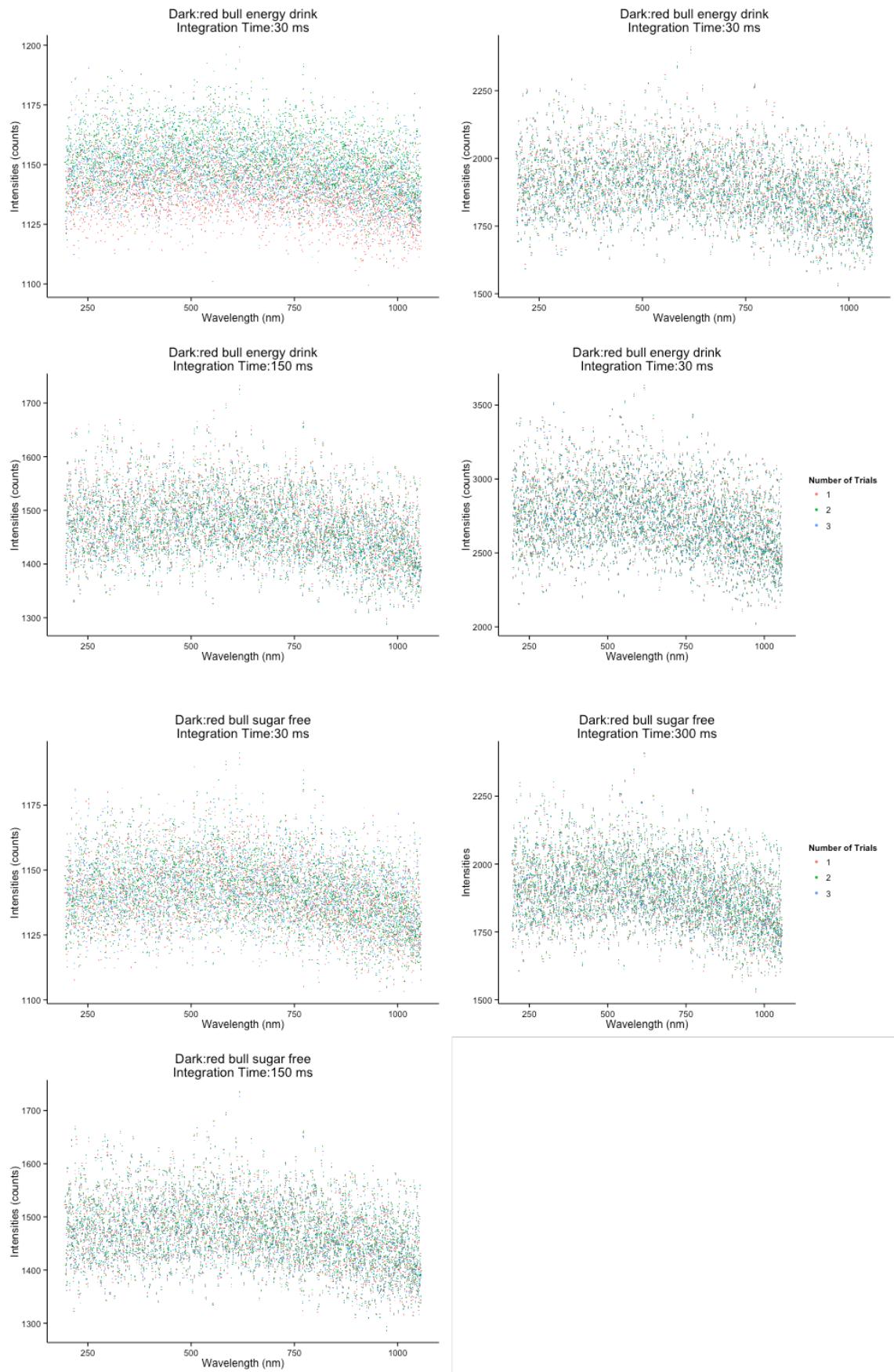


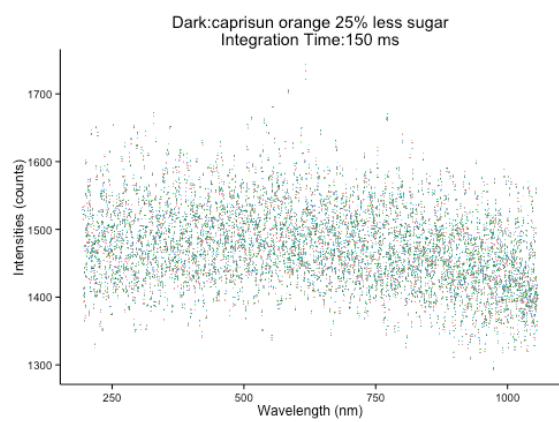
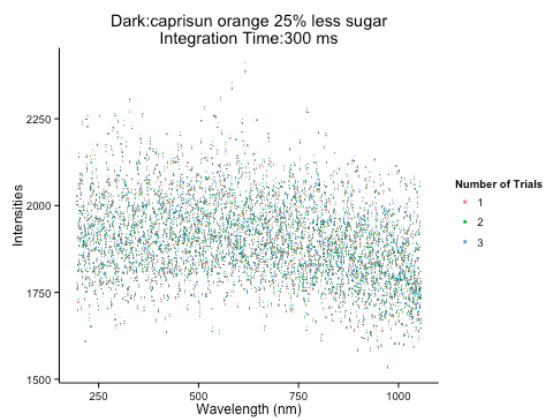
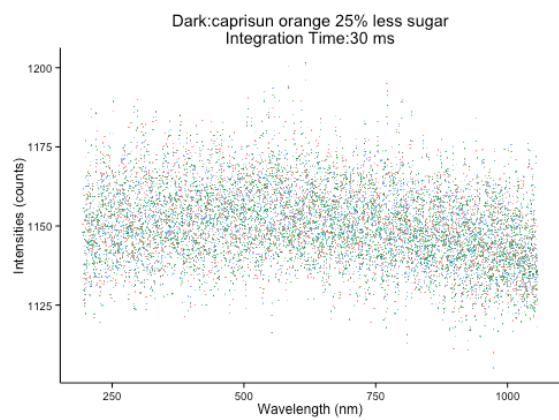
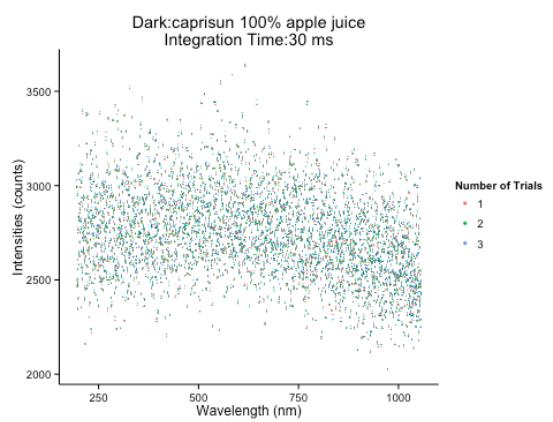
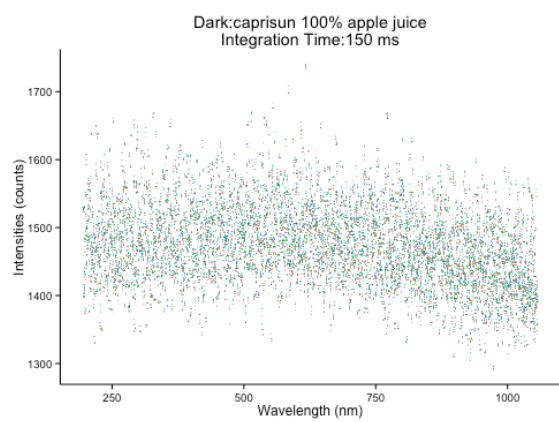
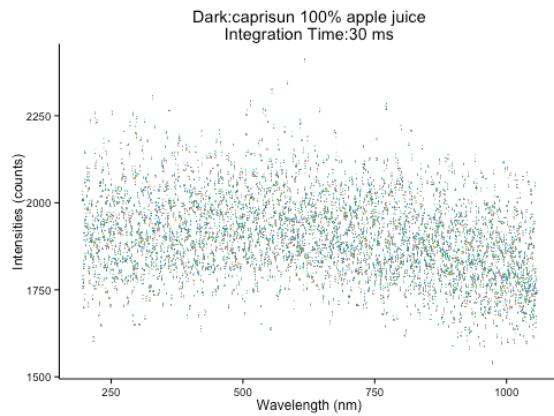
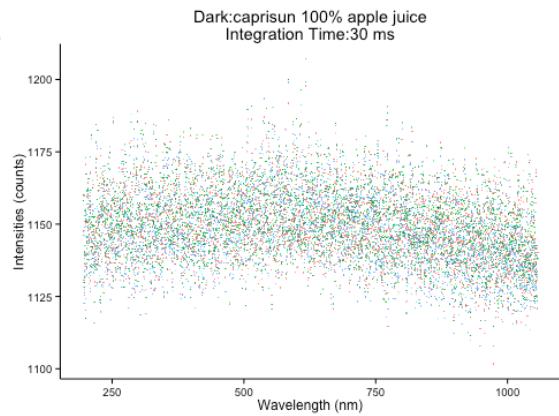
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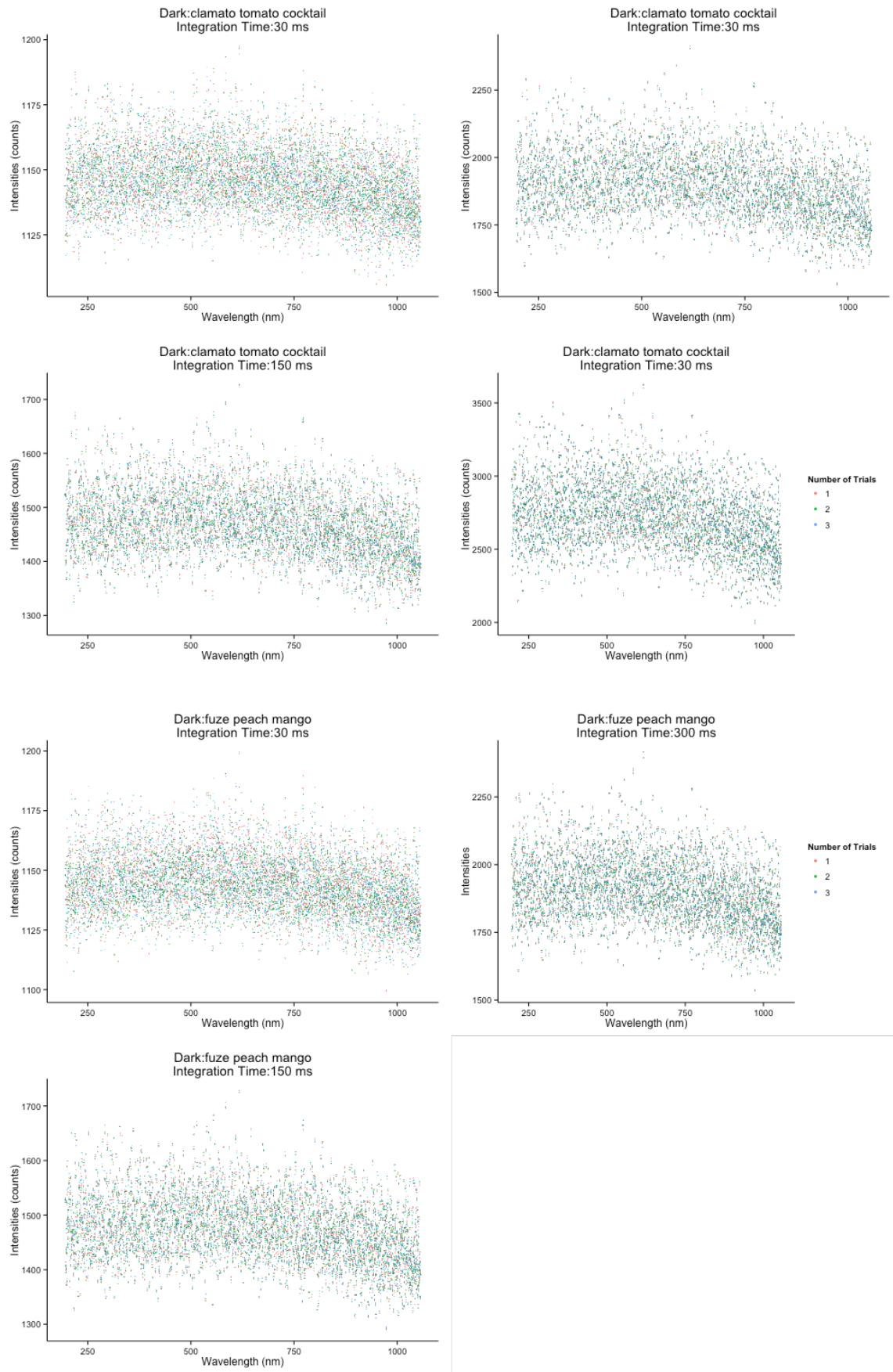


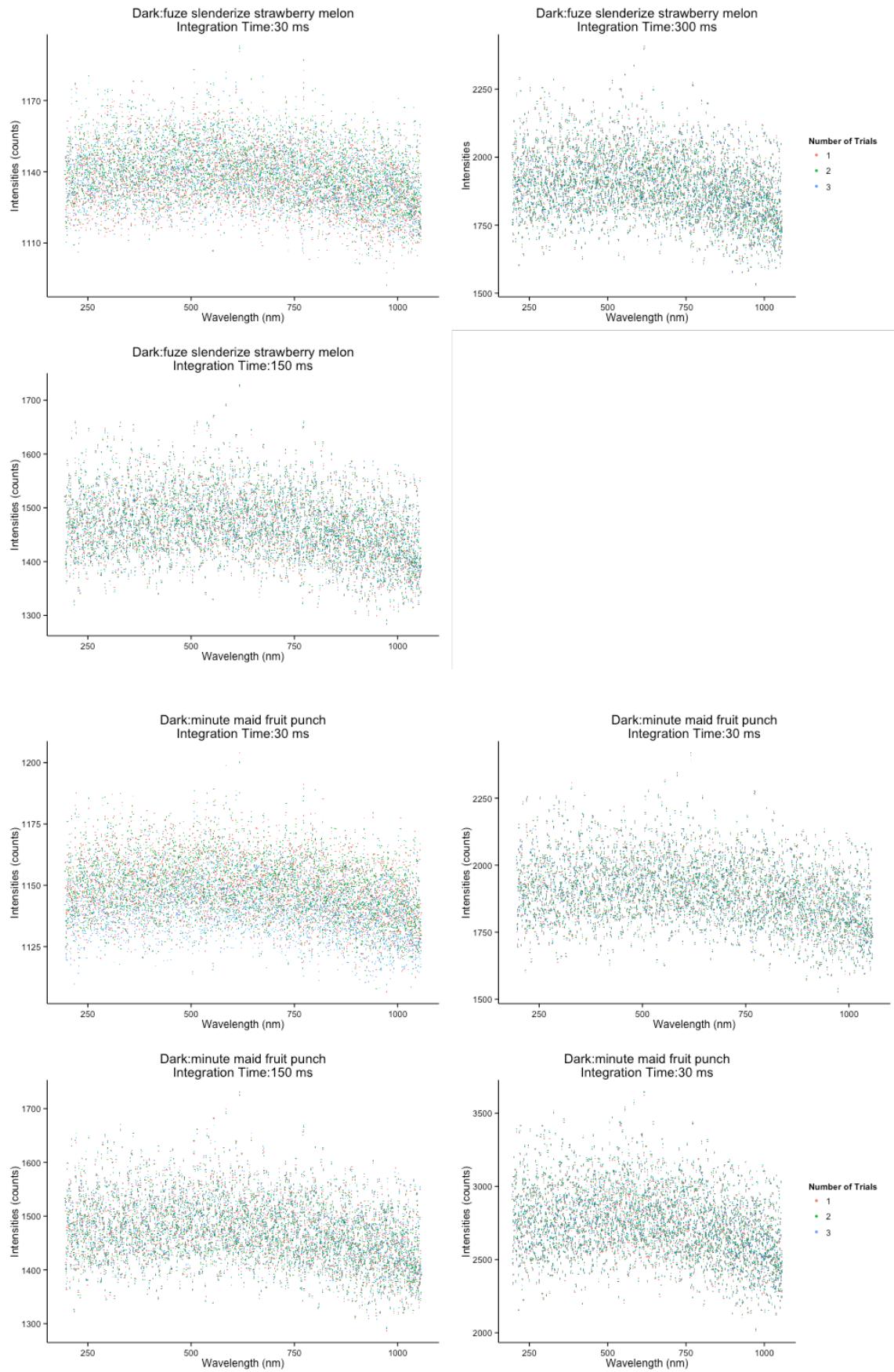


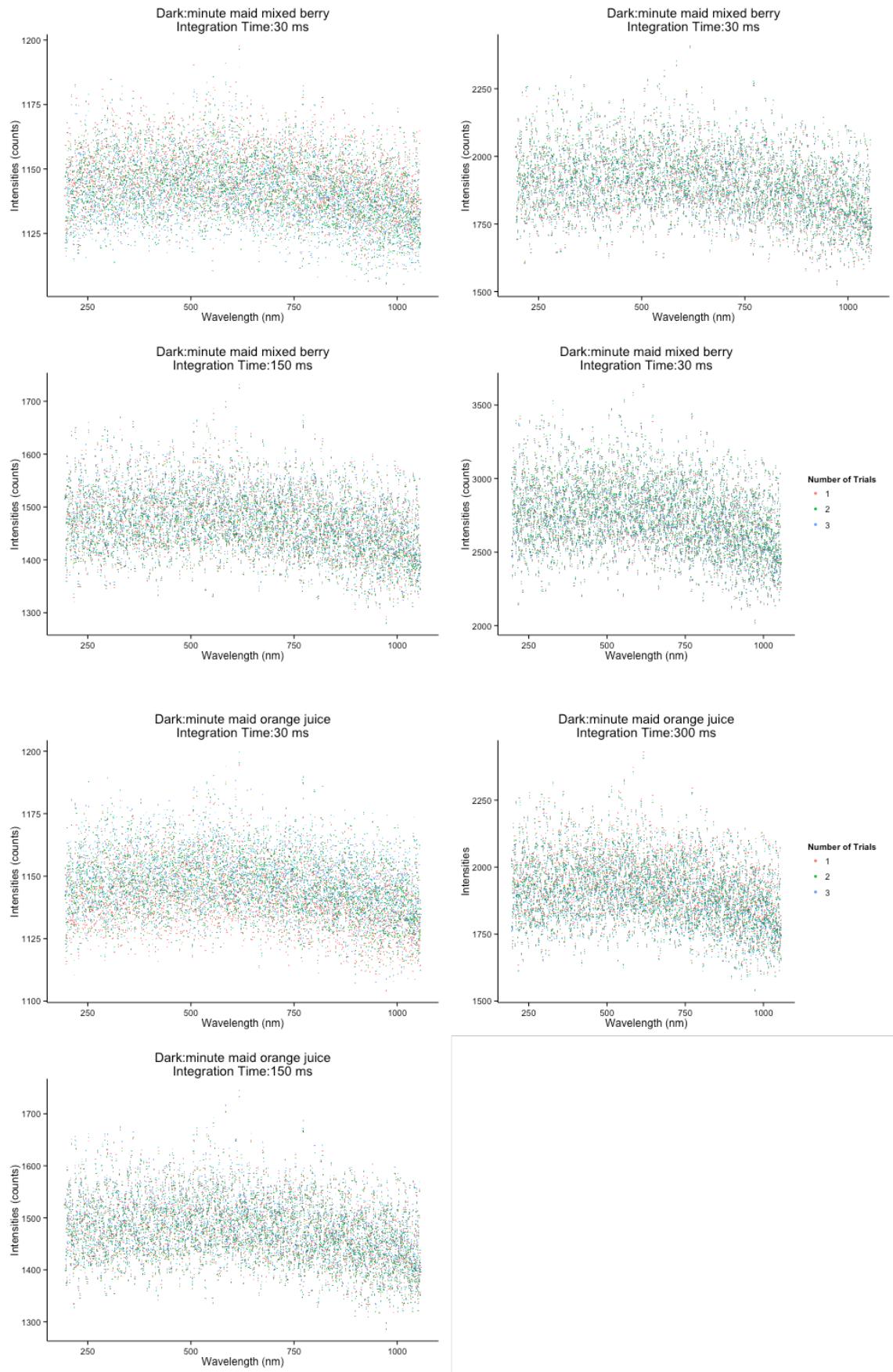


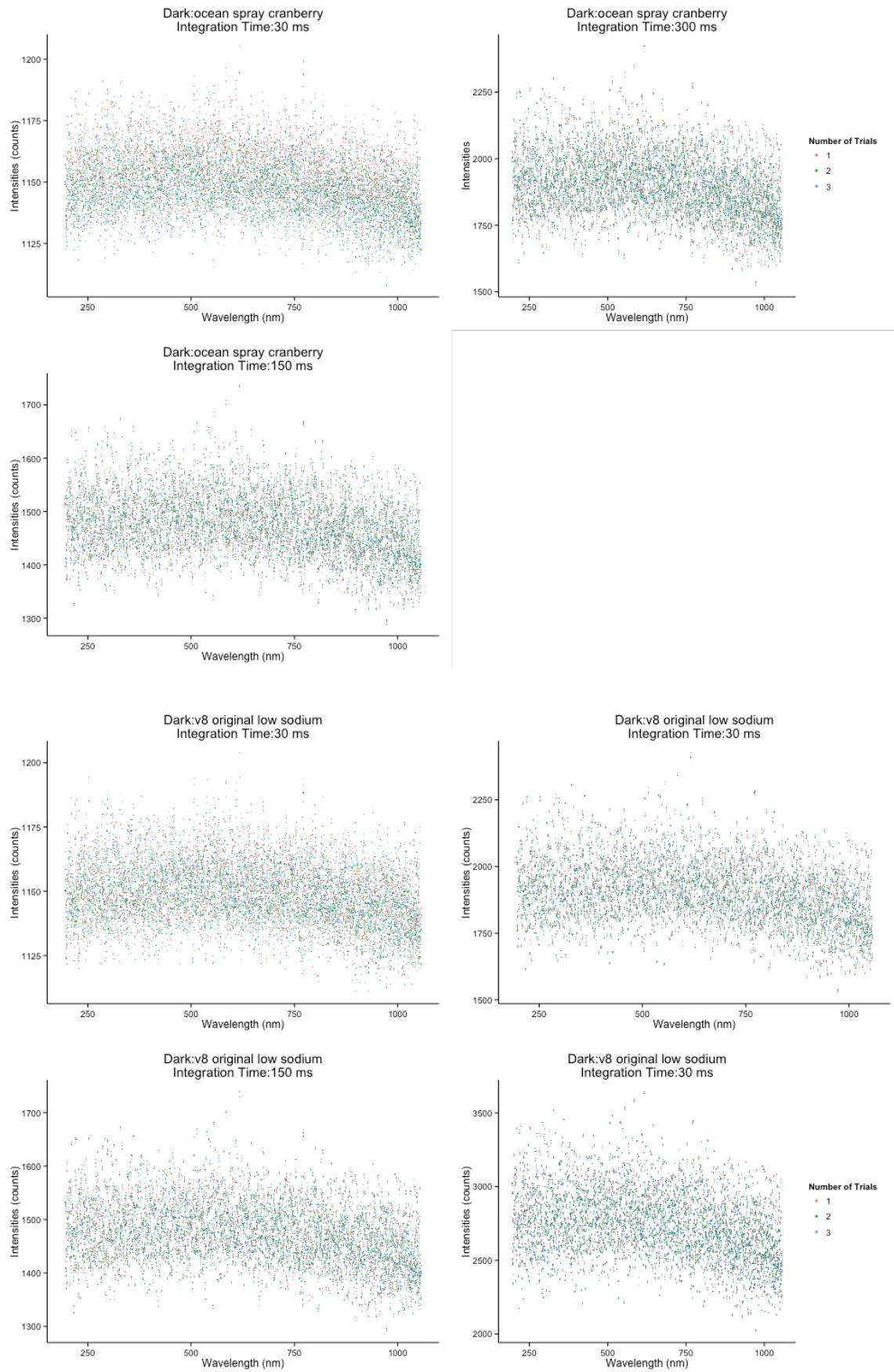




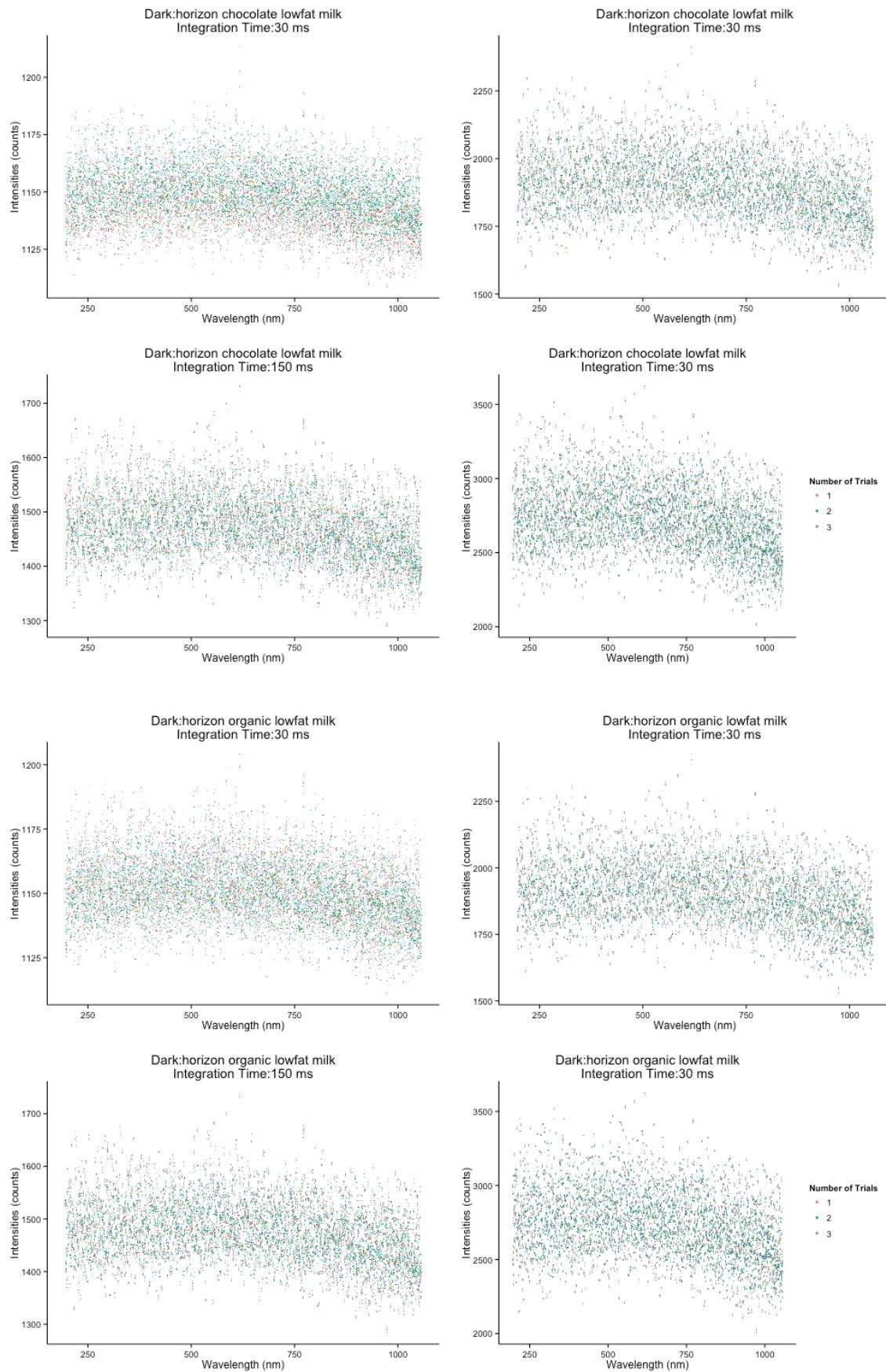


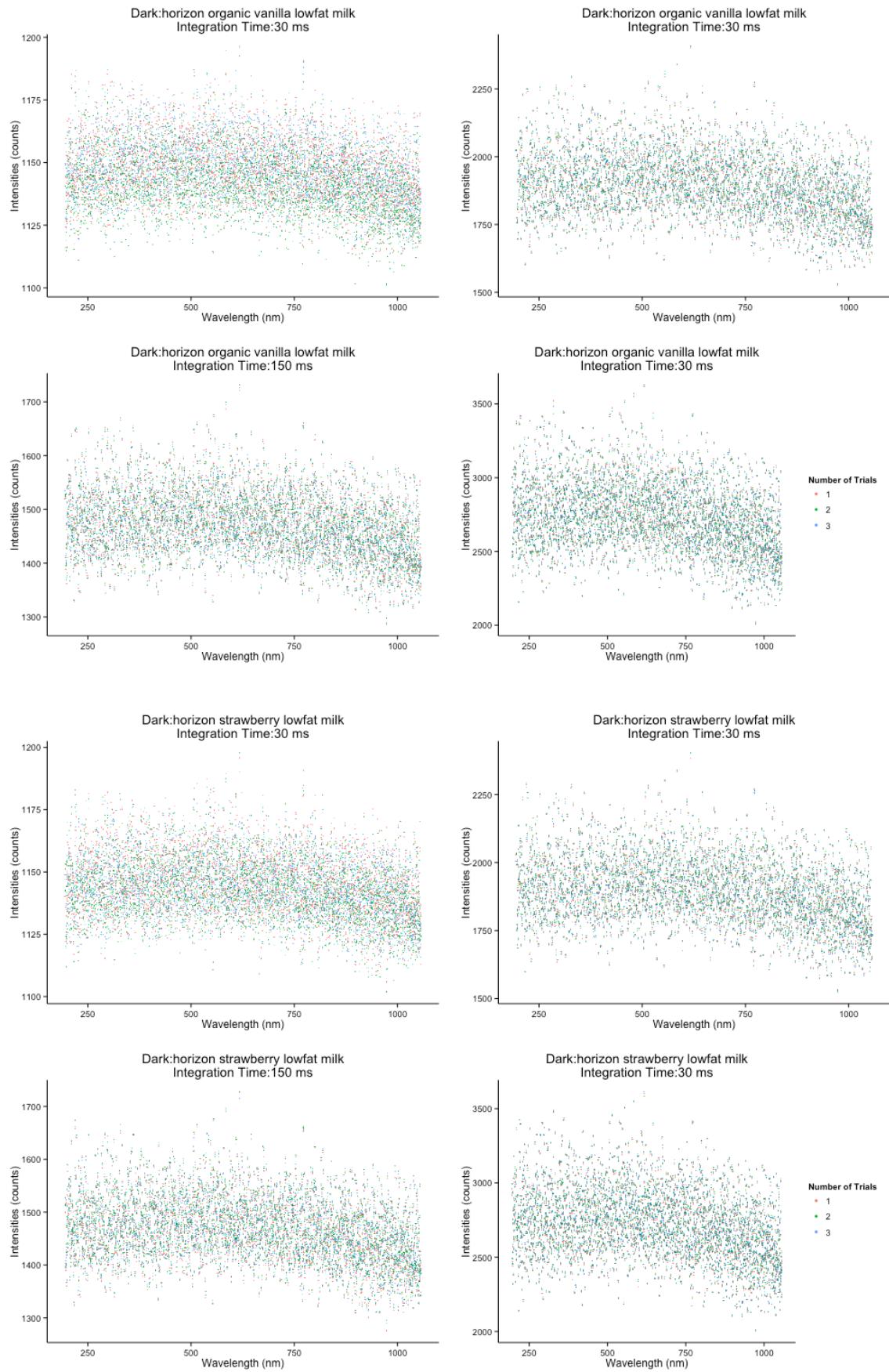


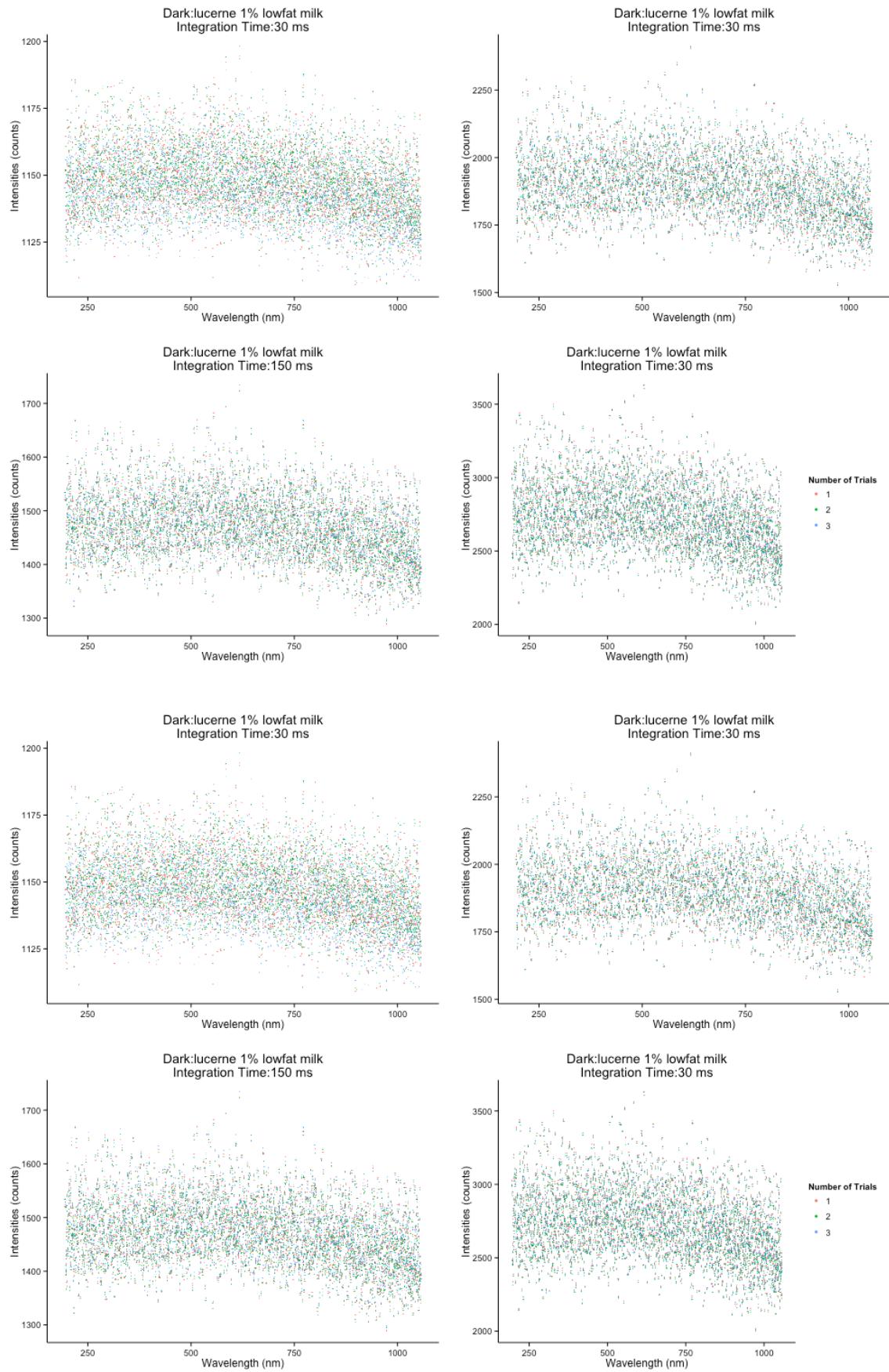


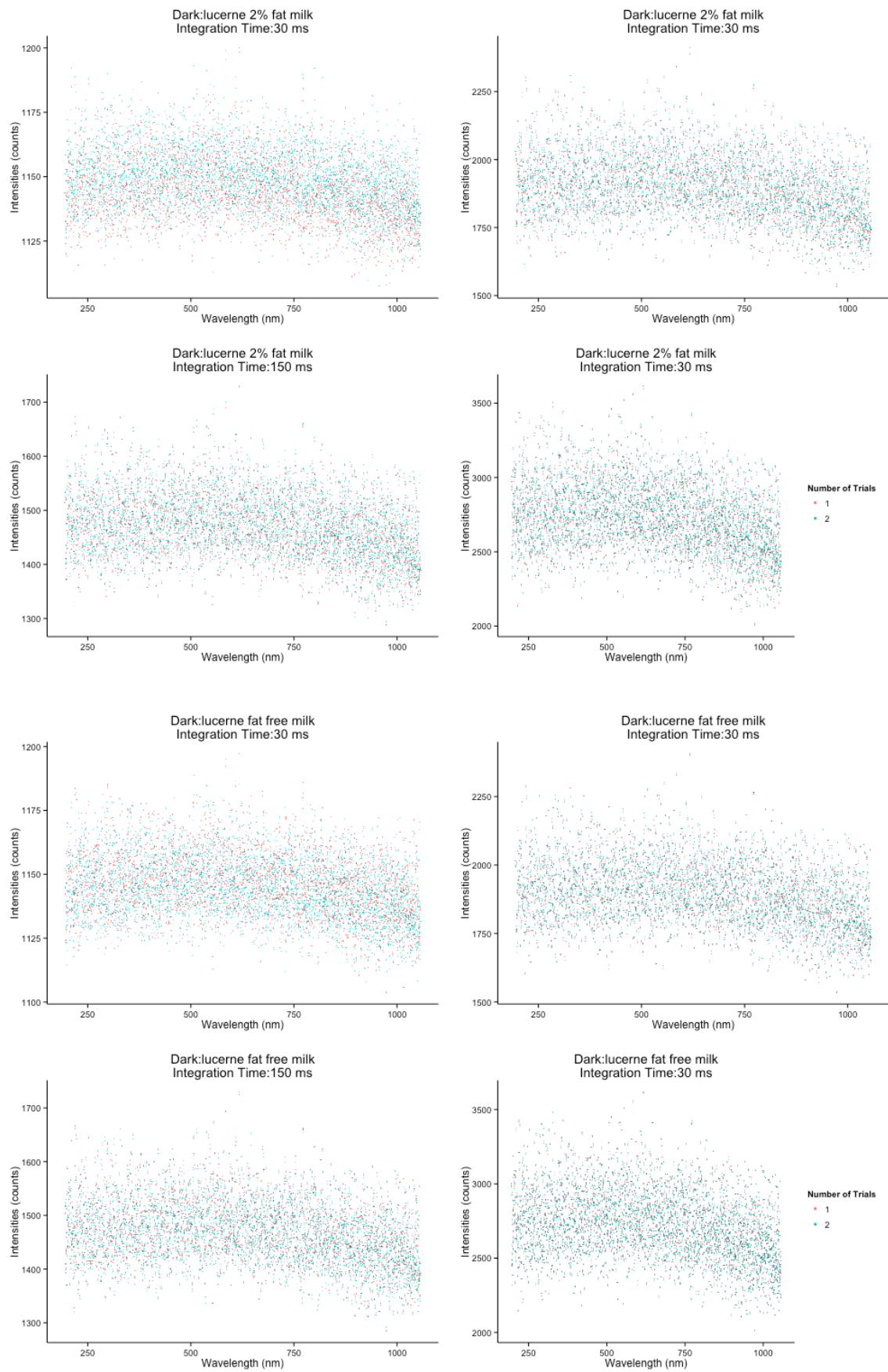


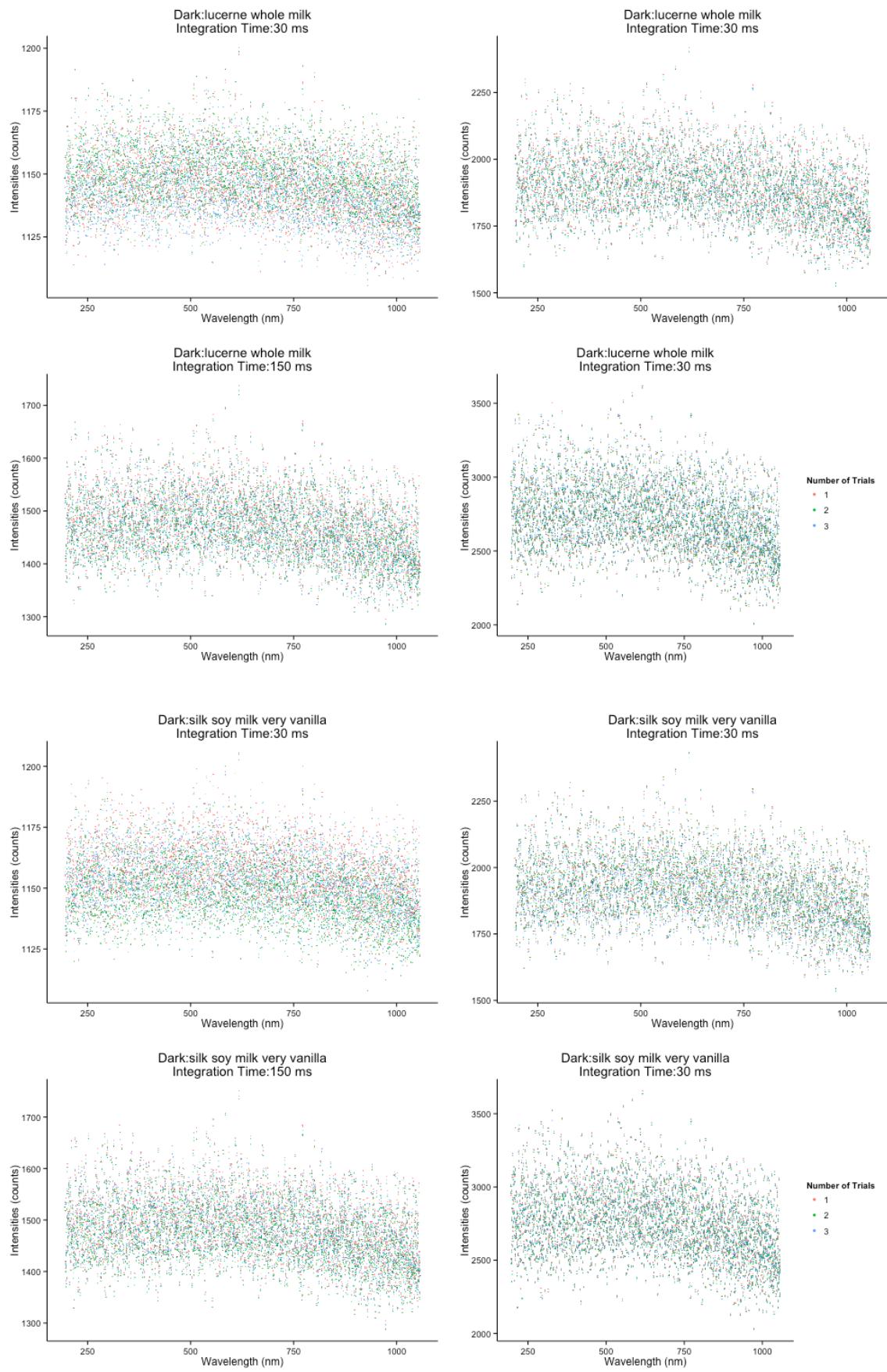
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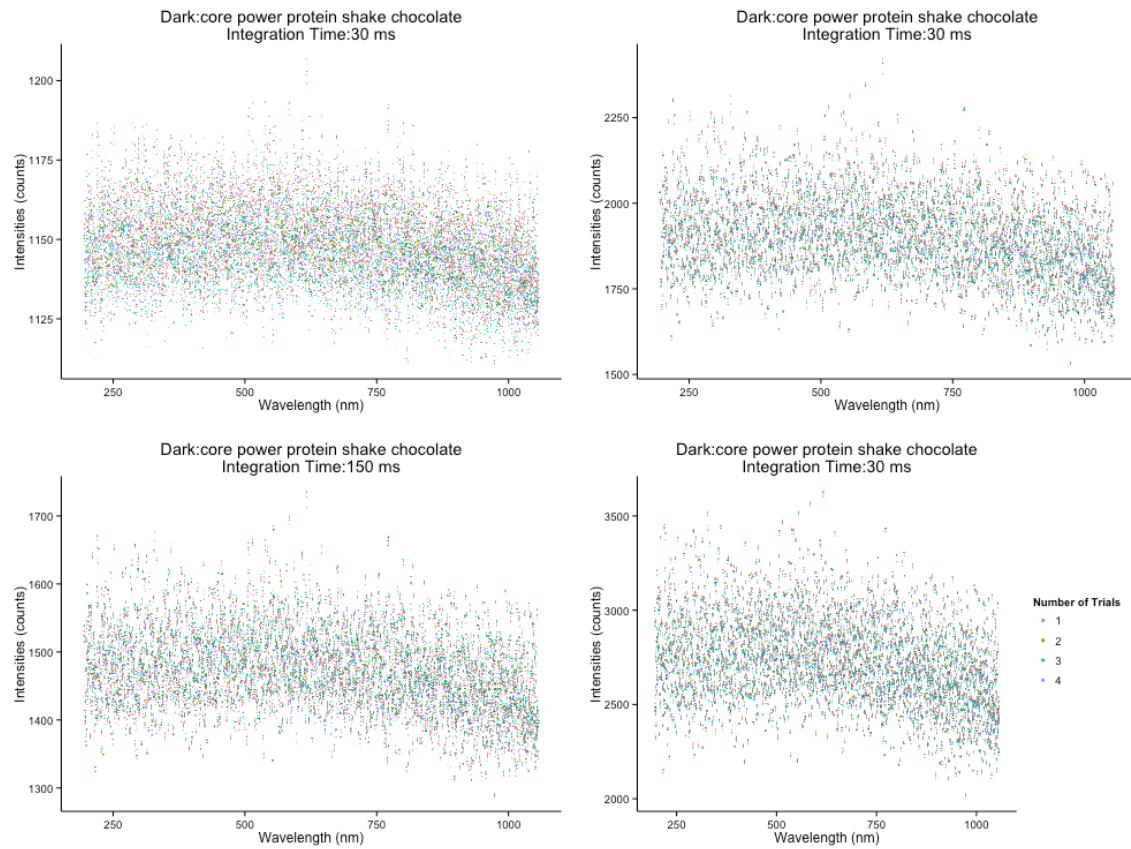


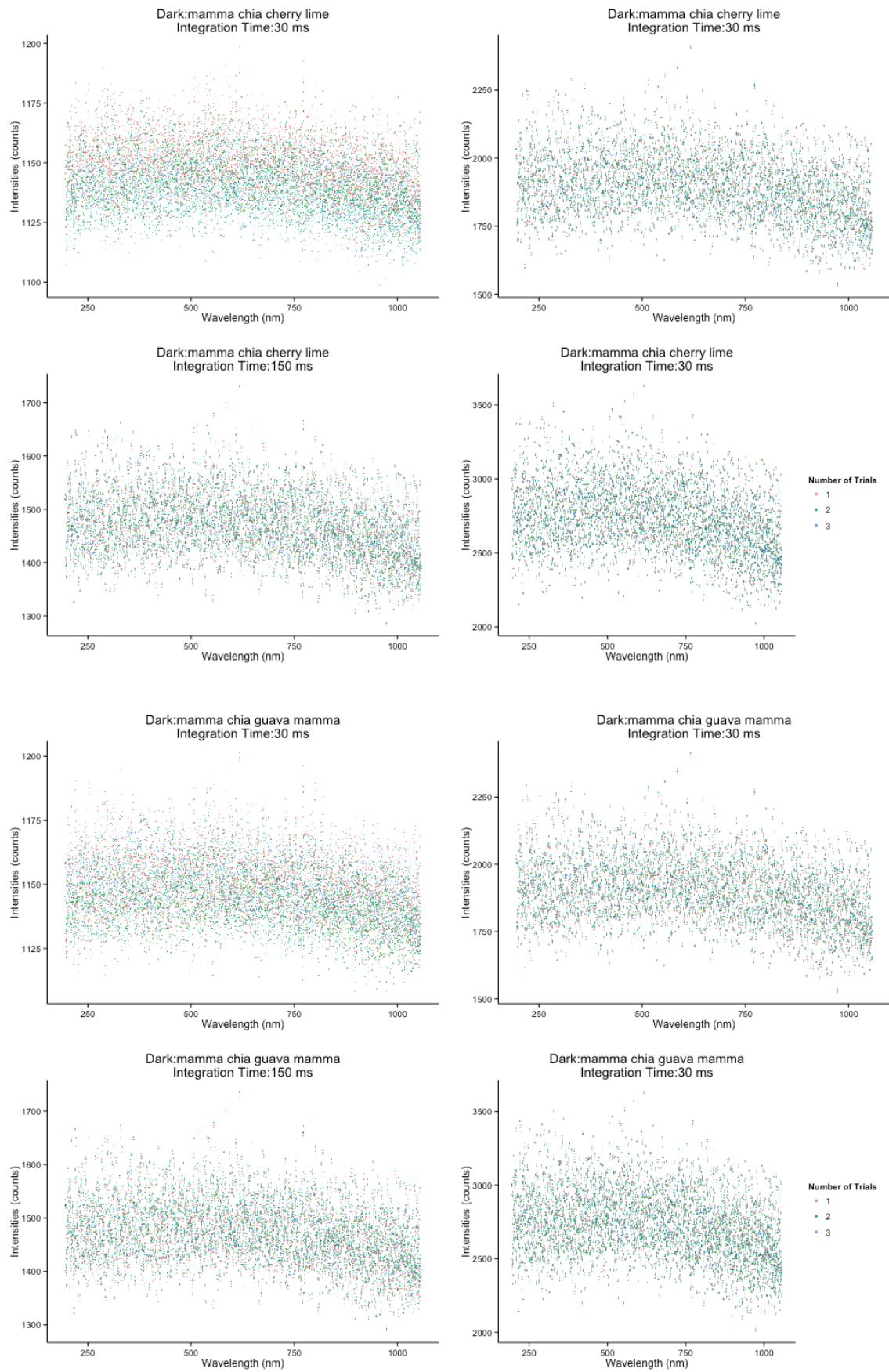


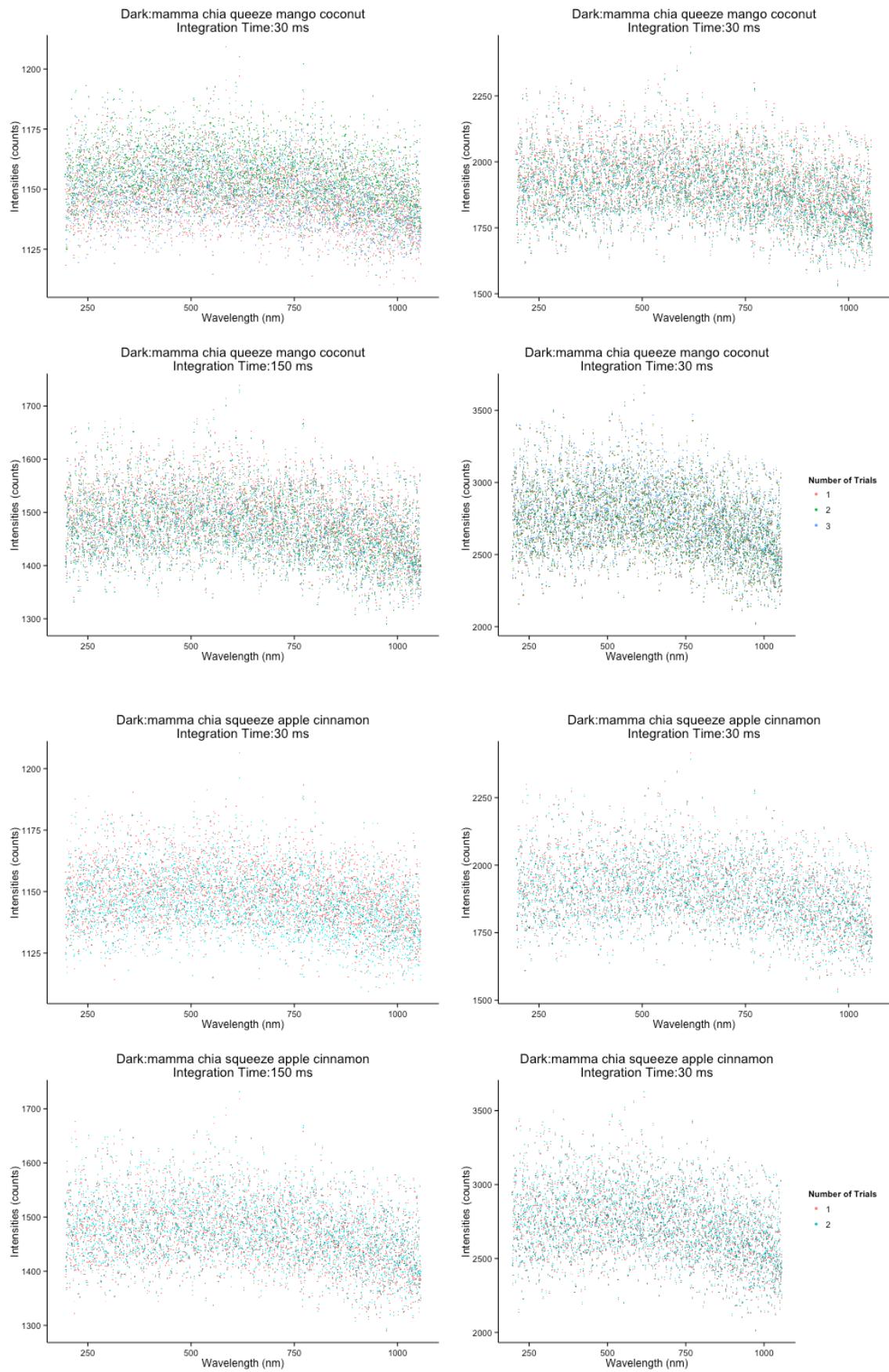


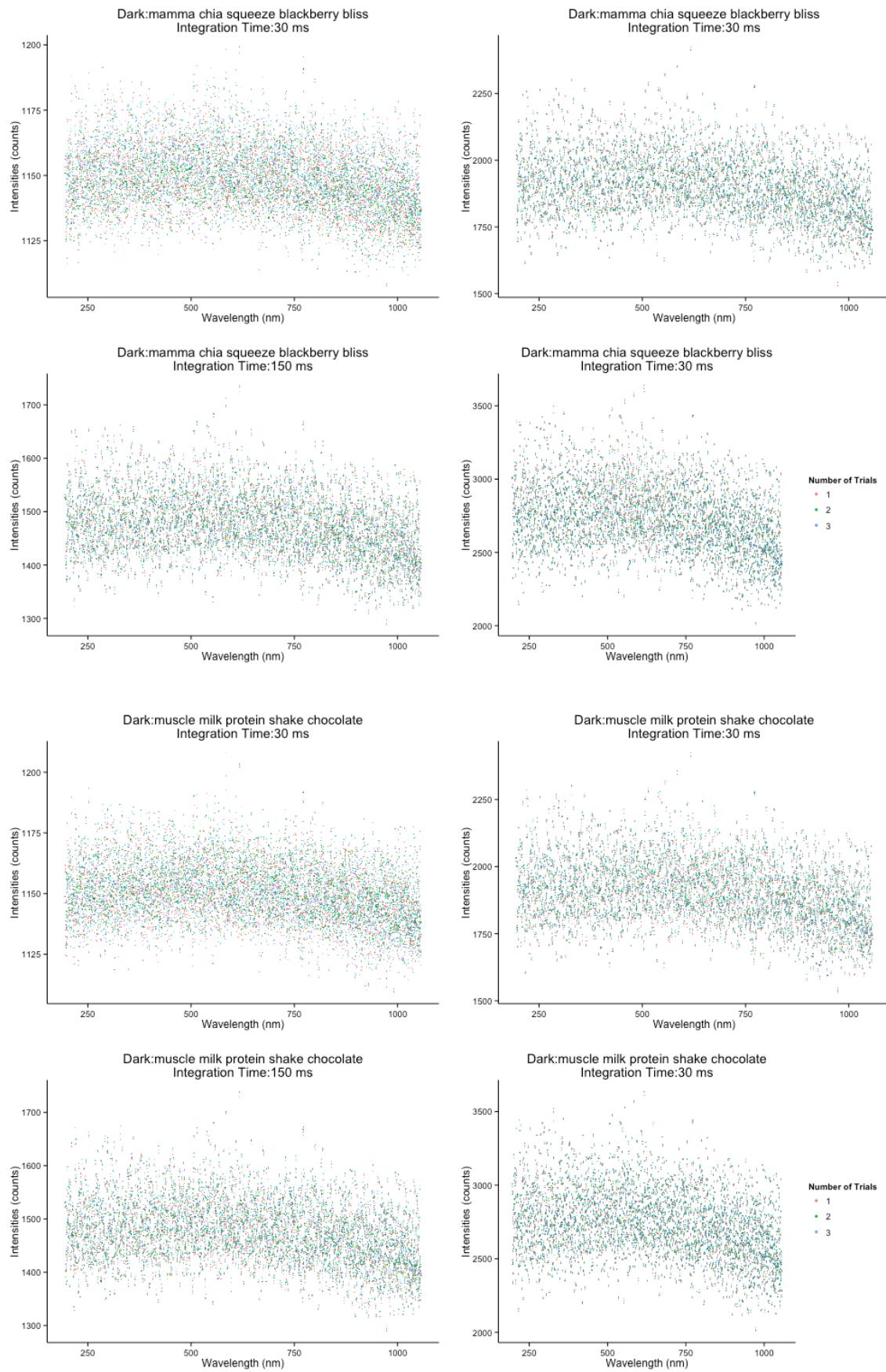


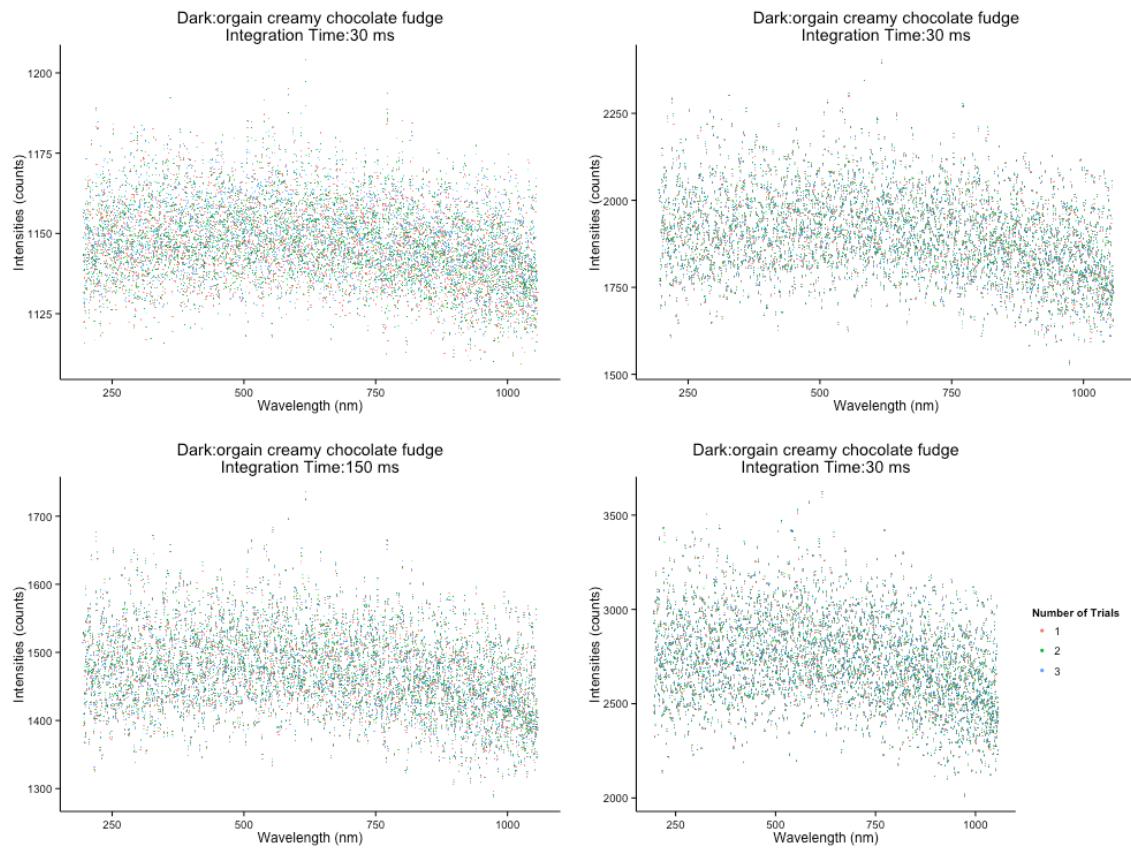
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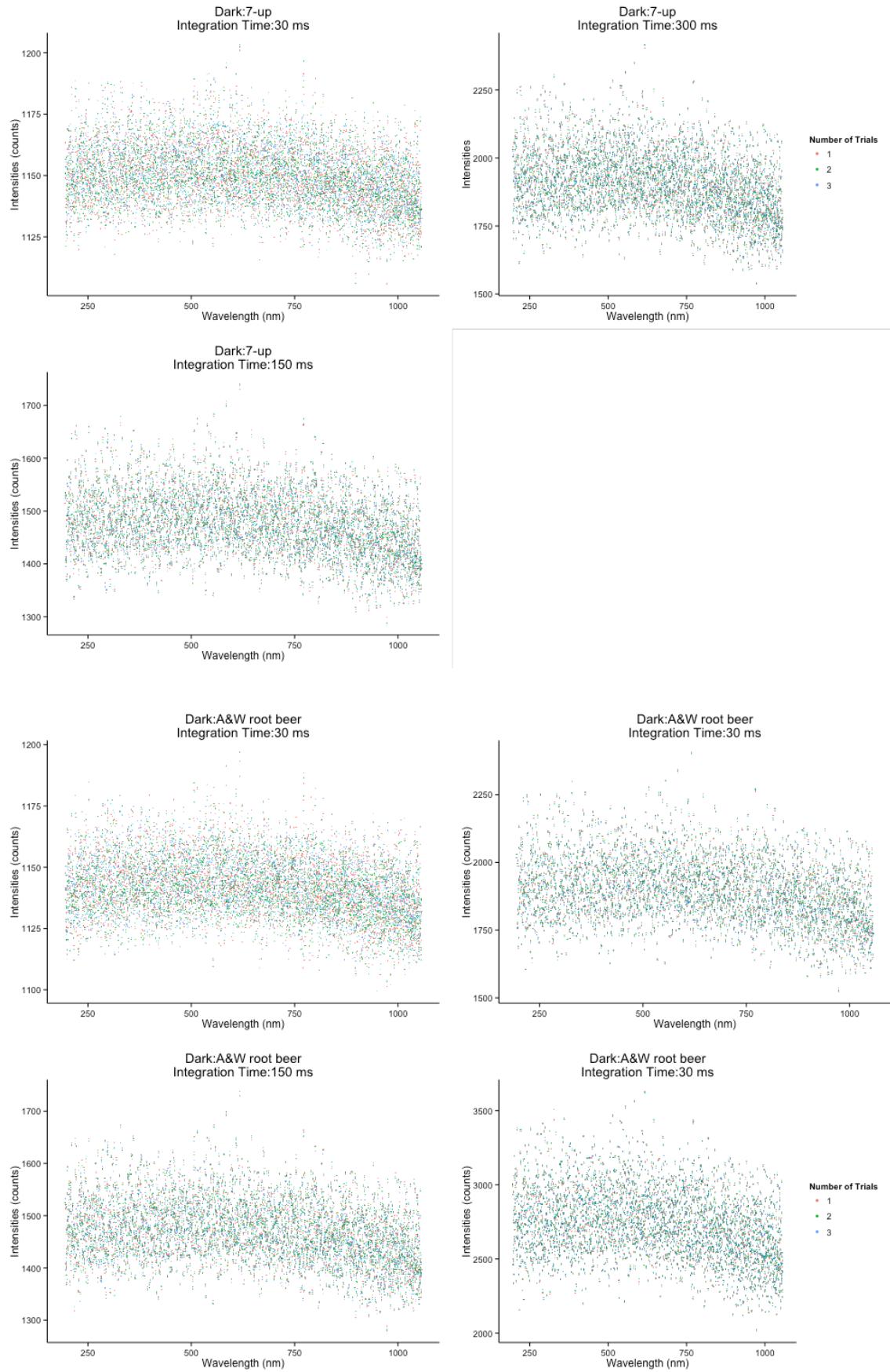


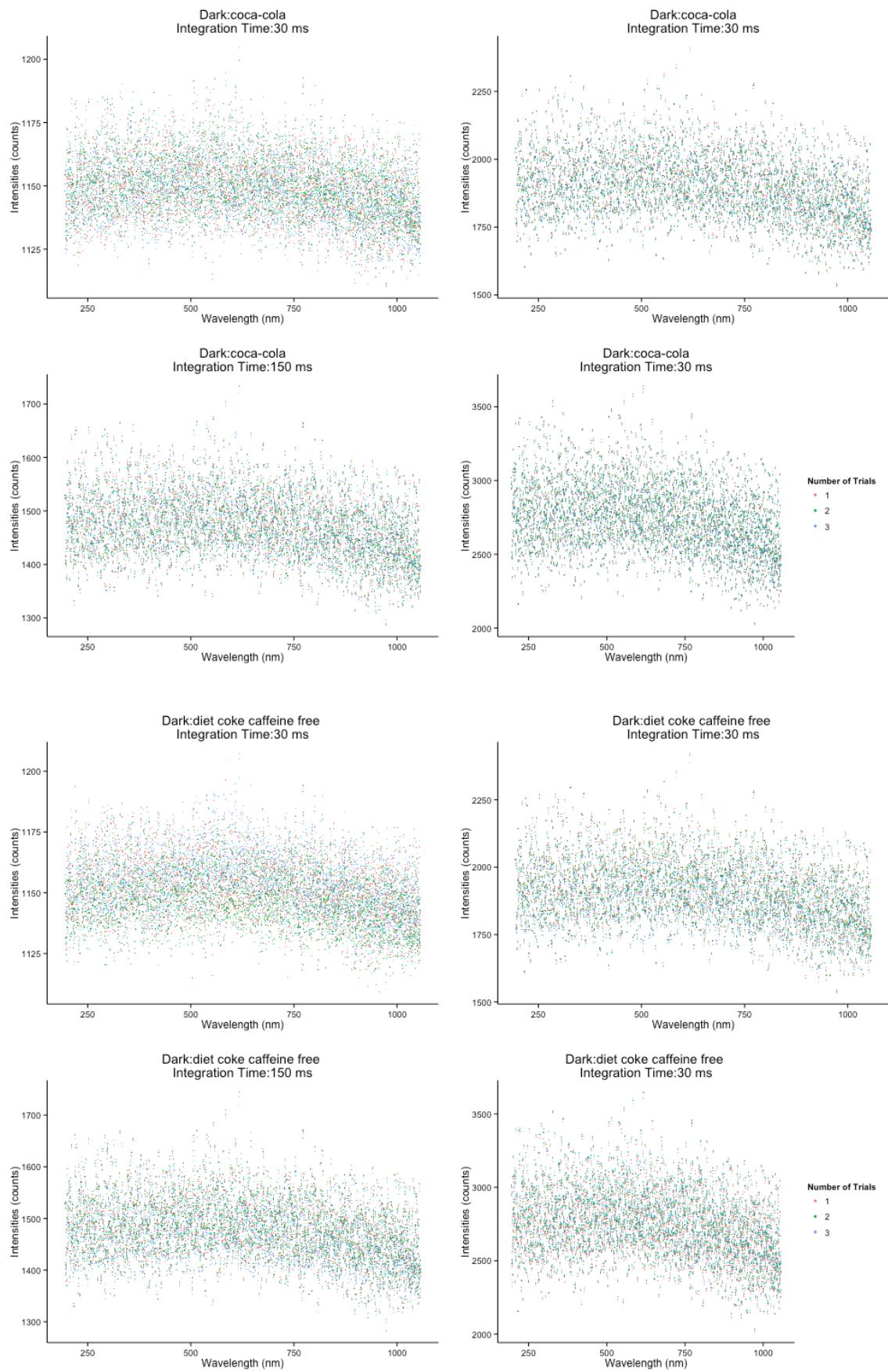


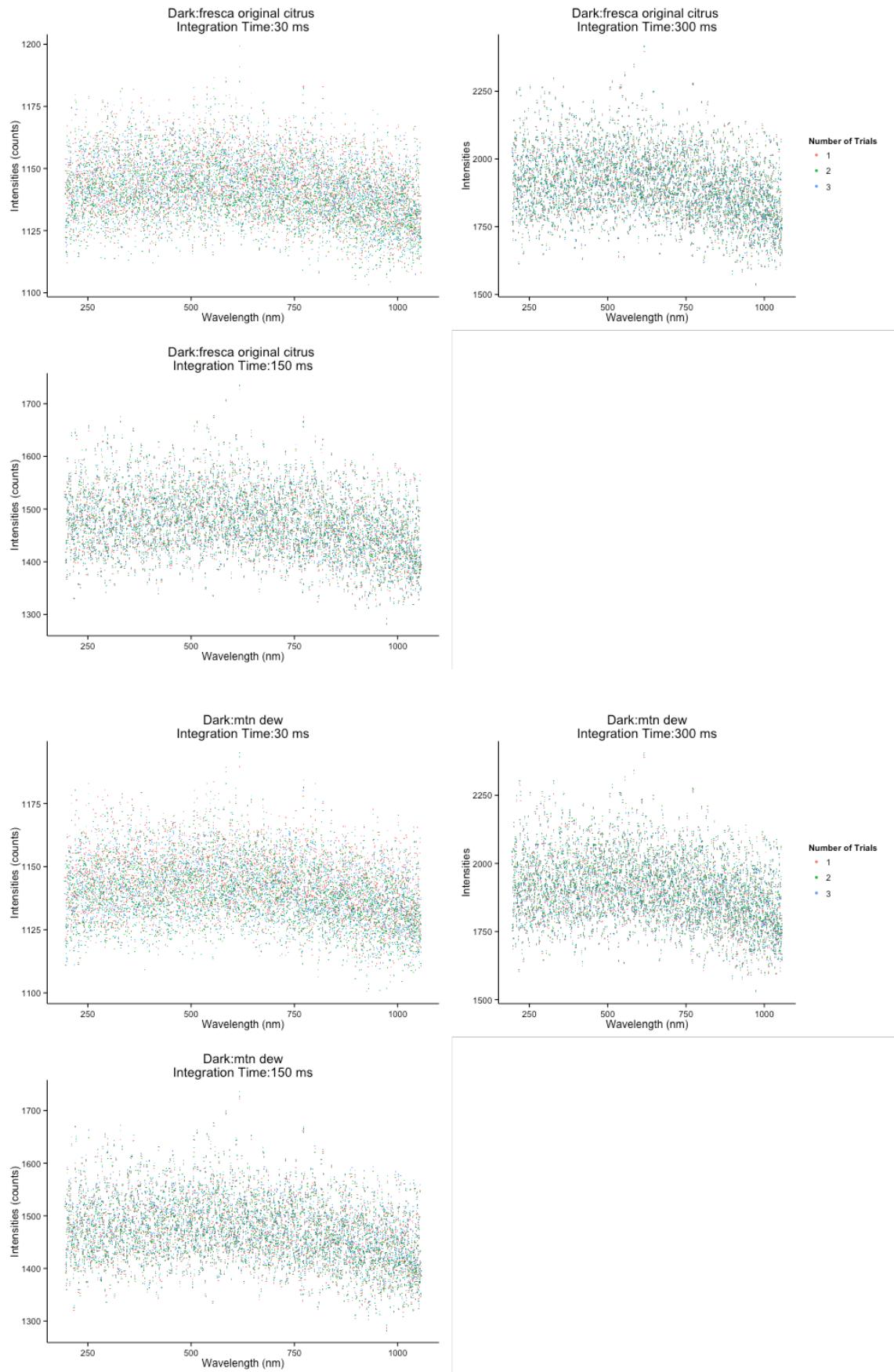


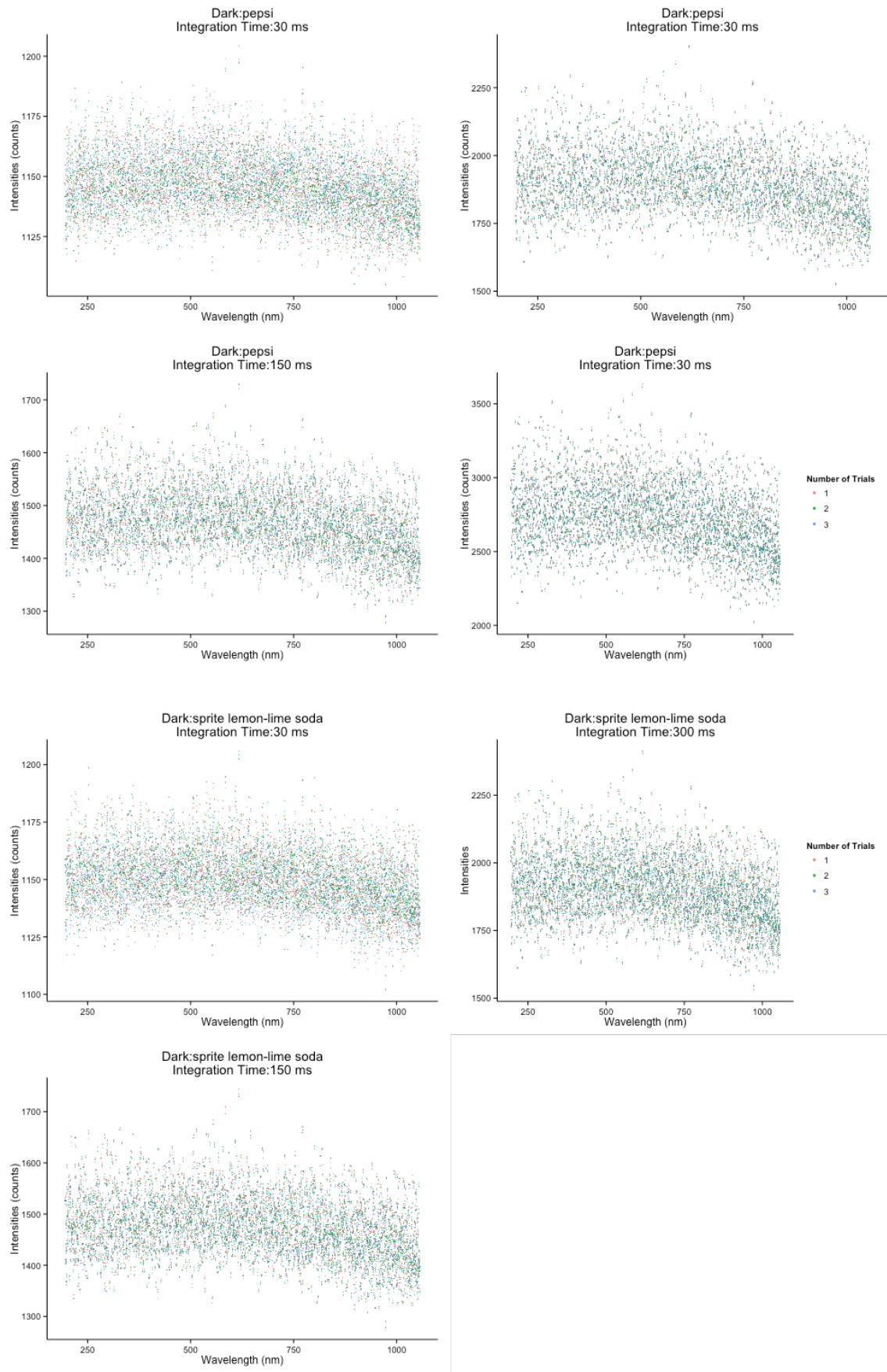


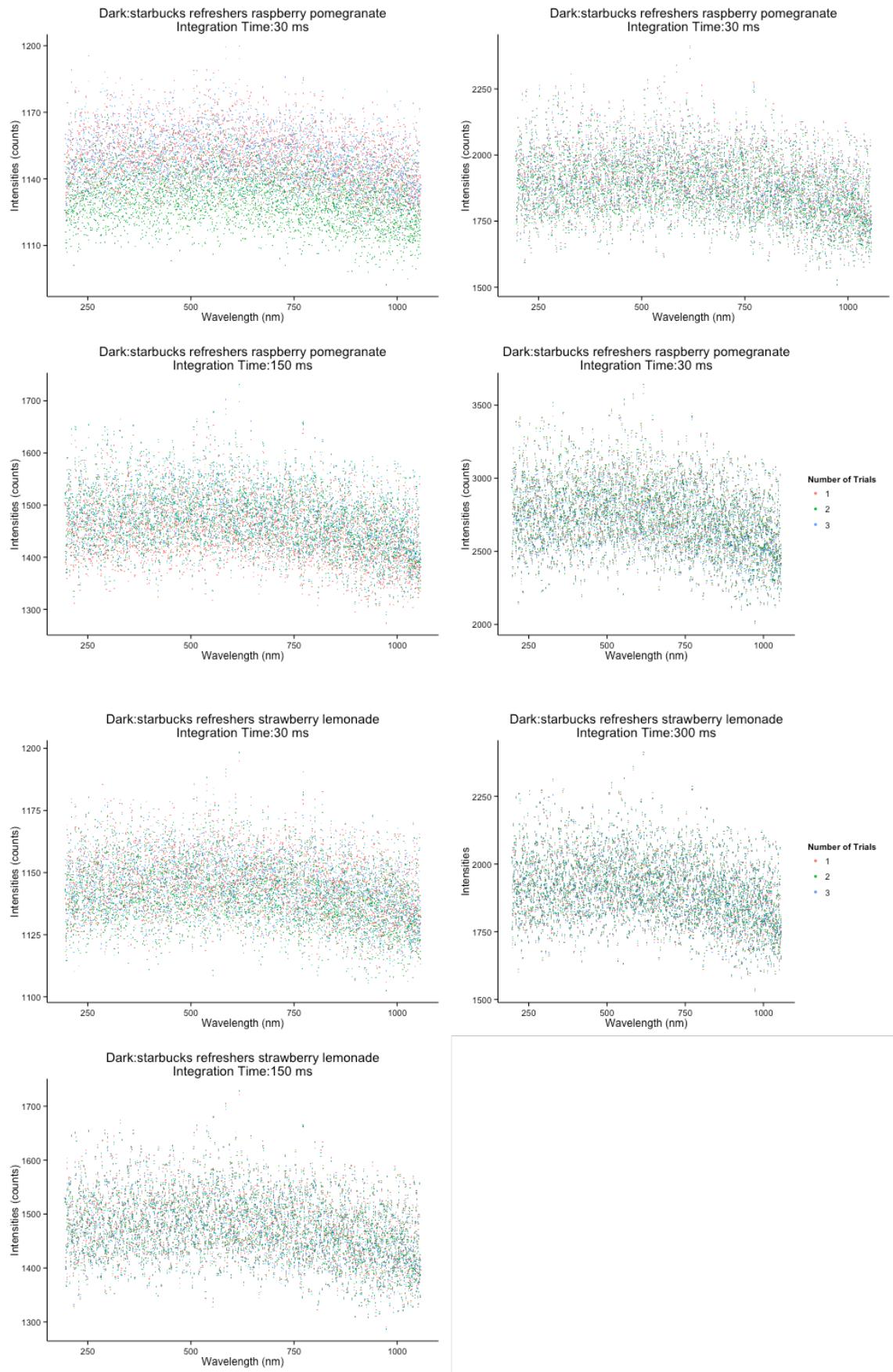
Soda



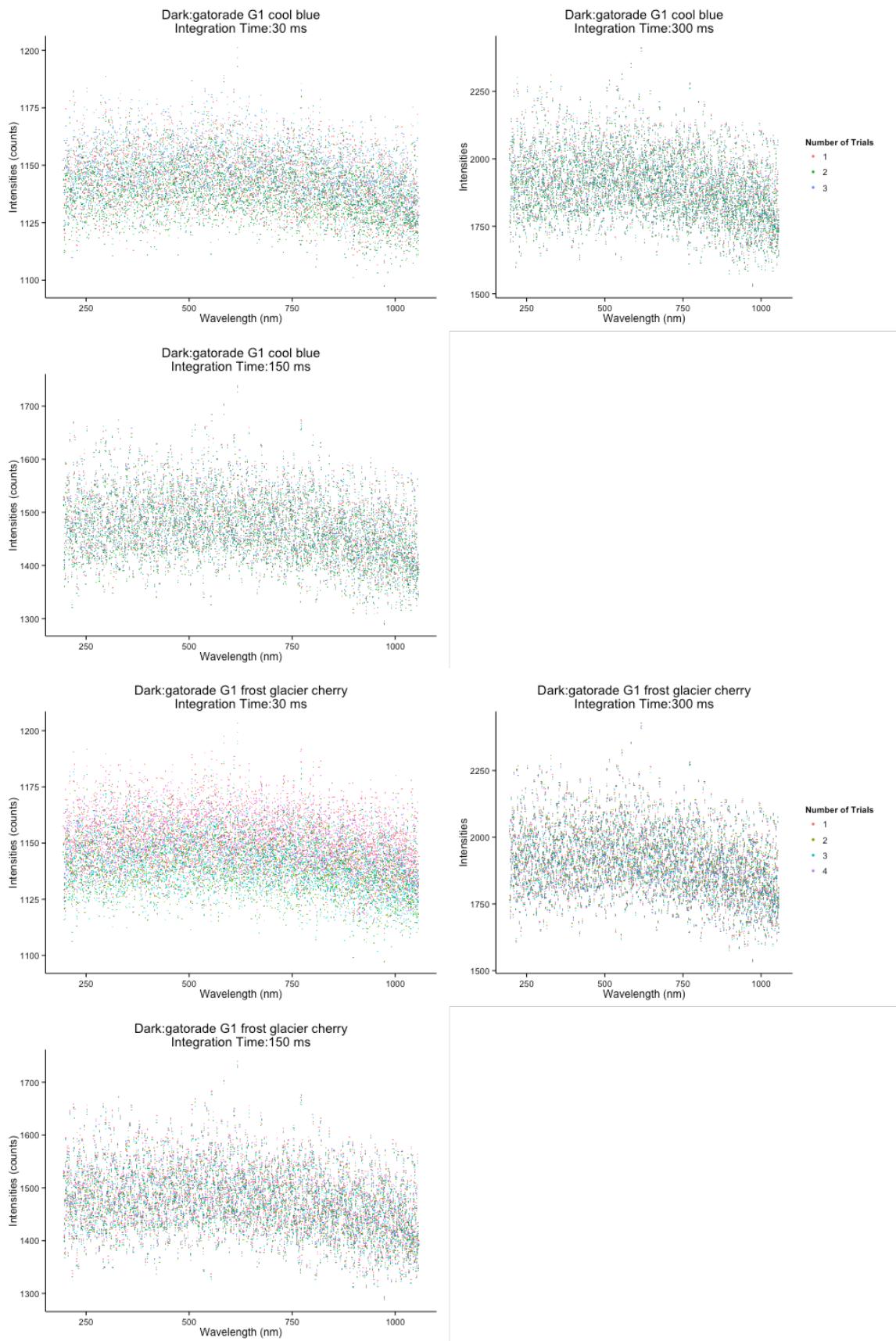


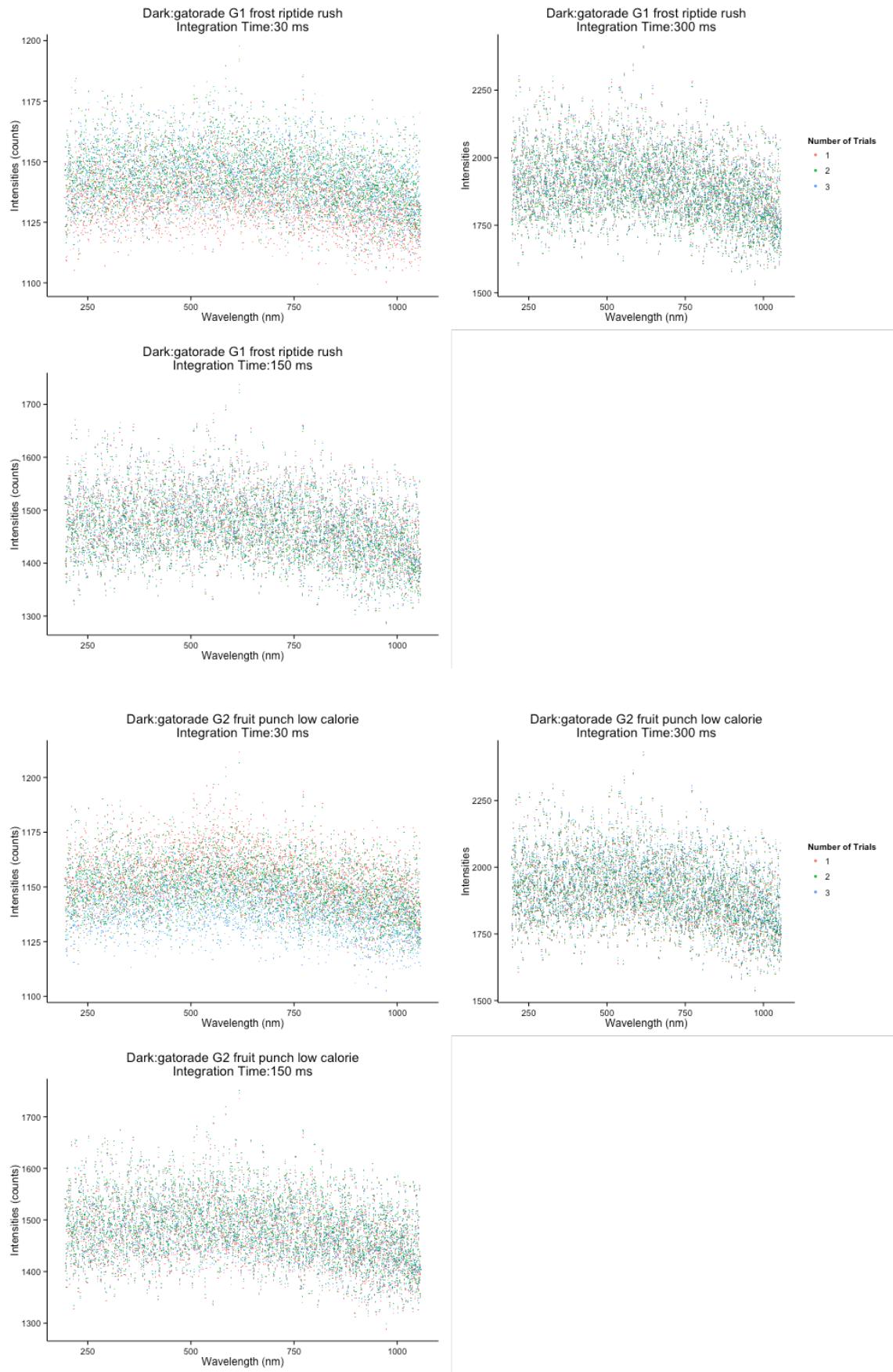


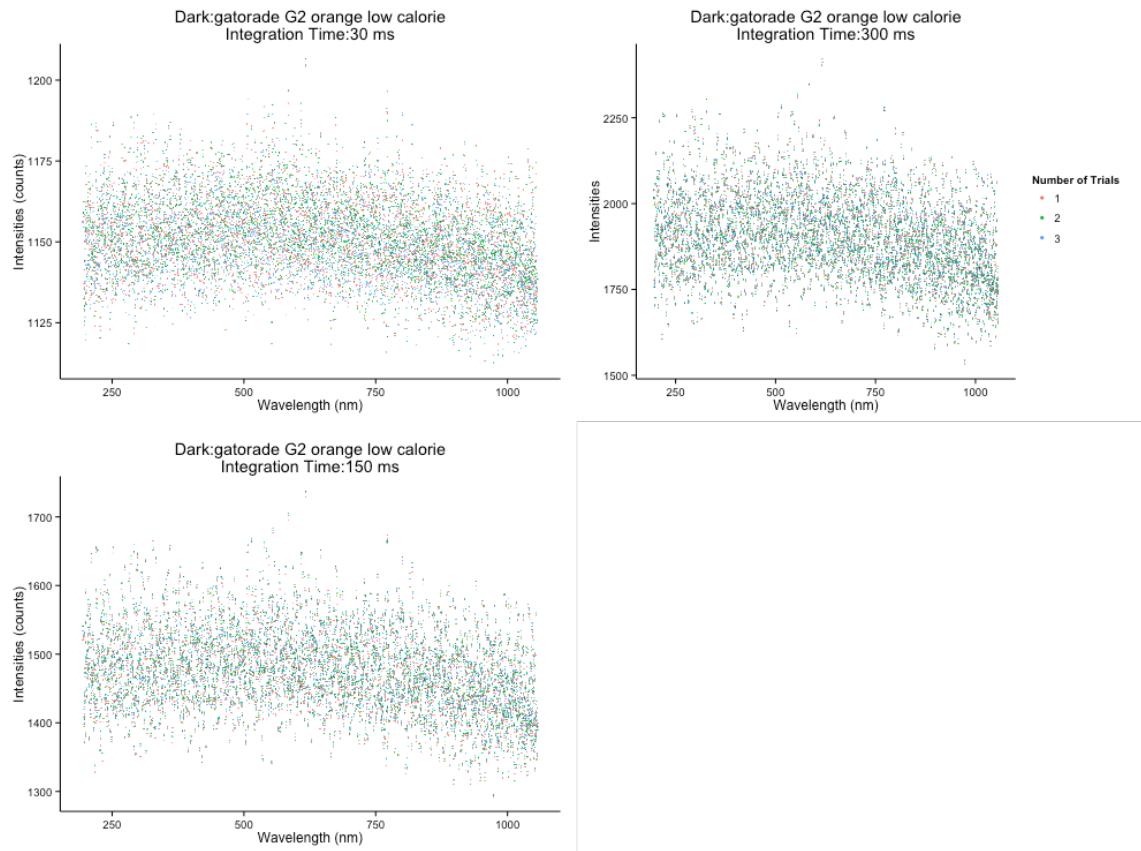


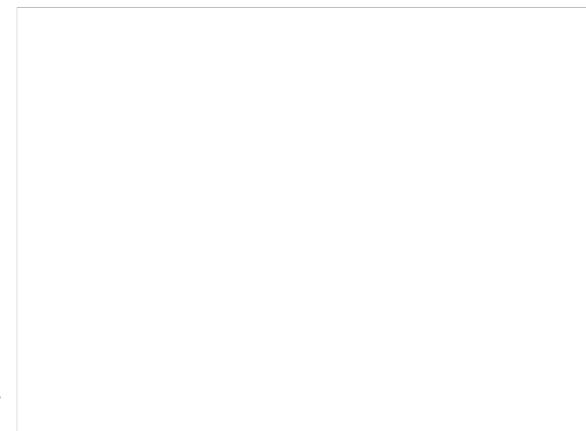
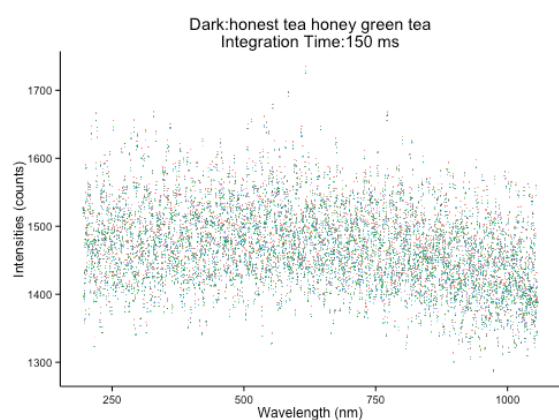
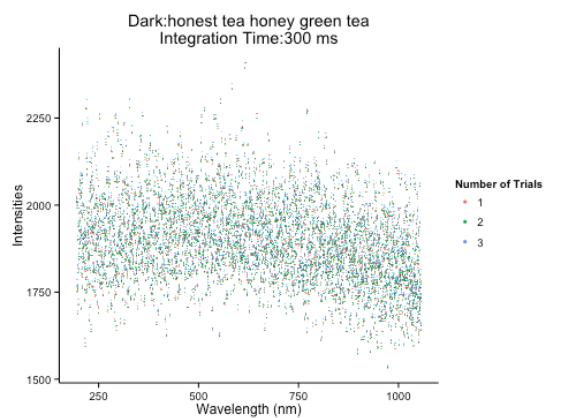
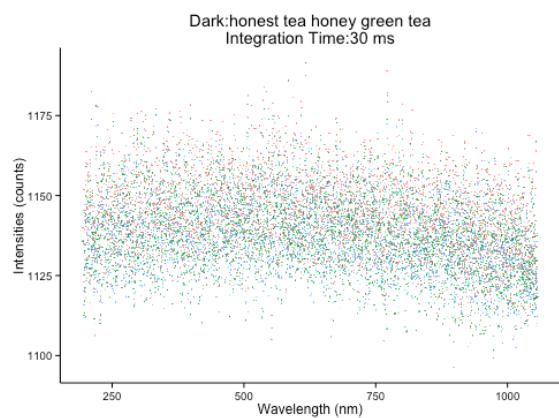
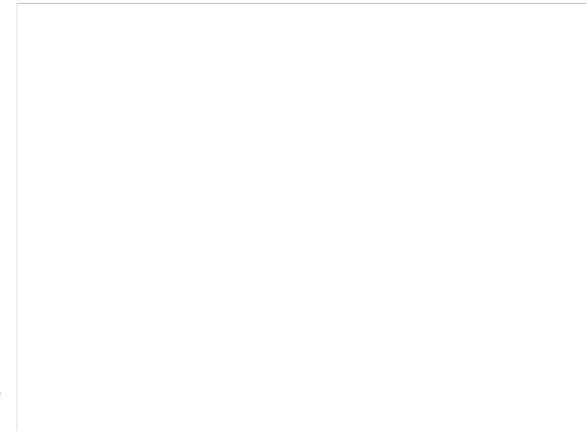
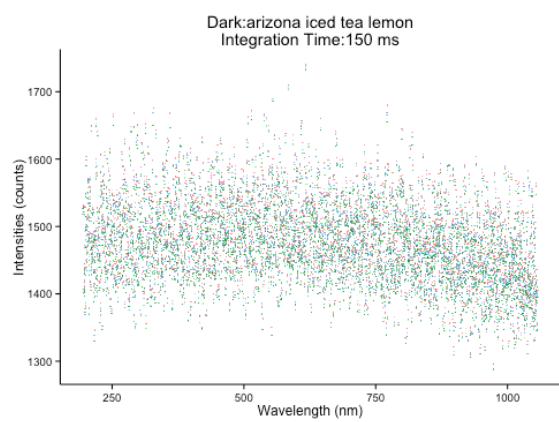
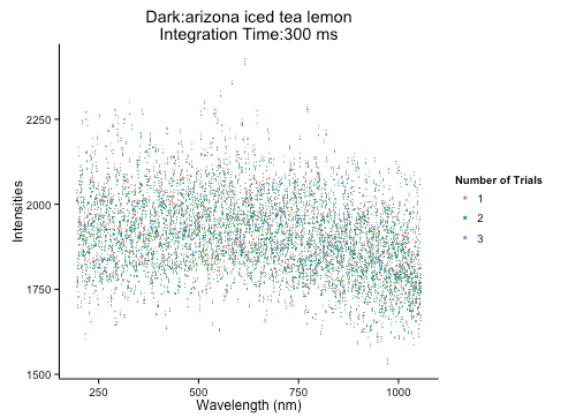
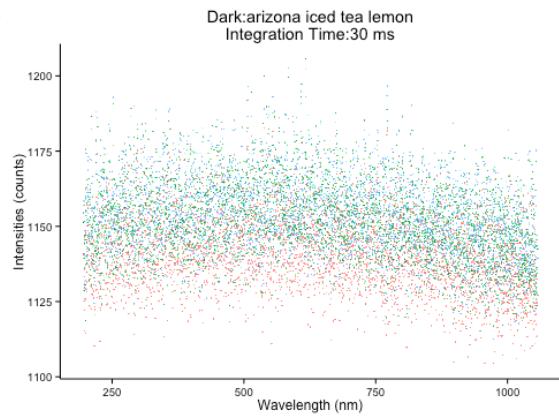


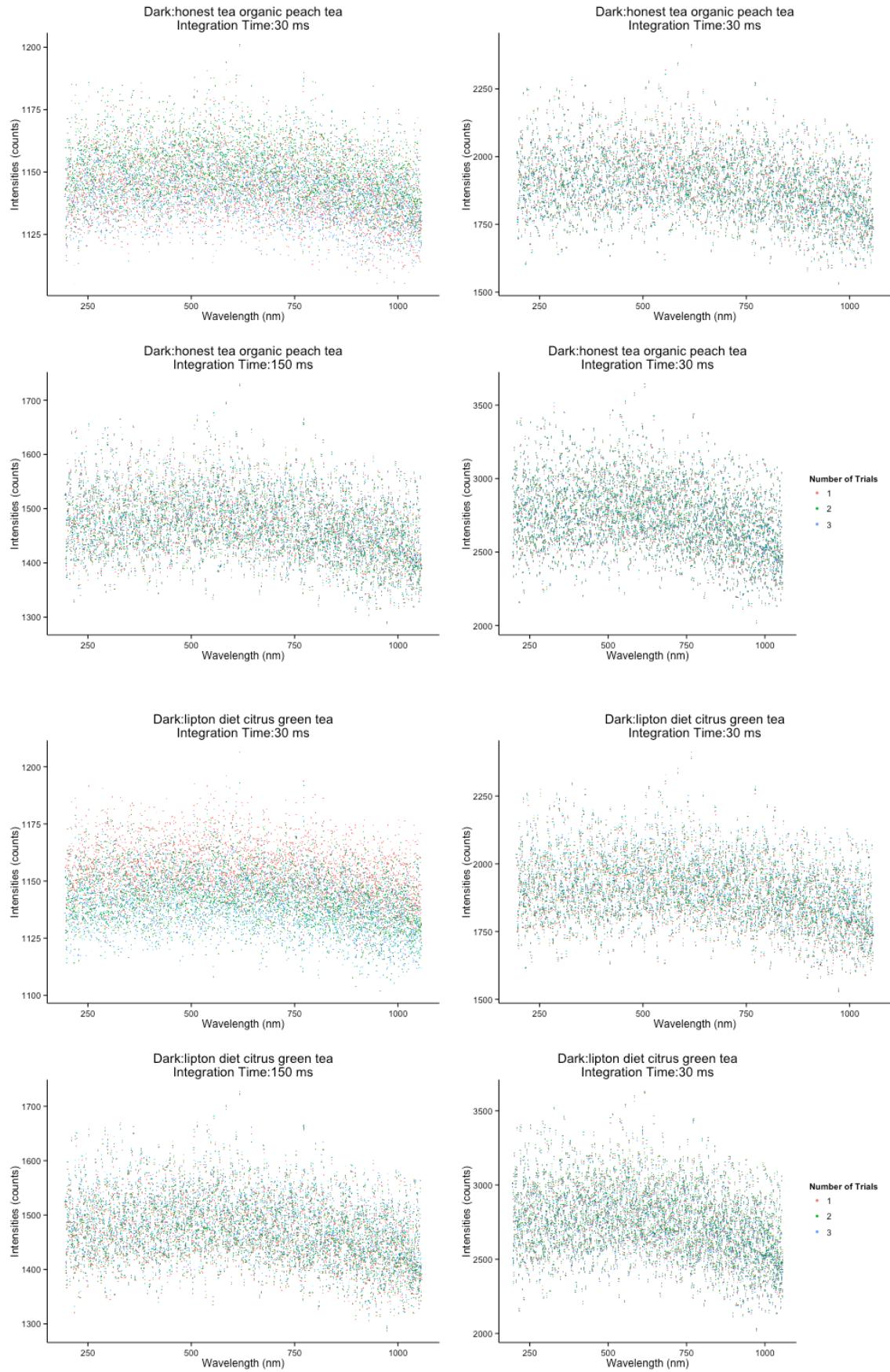
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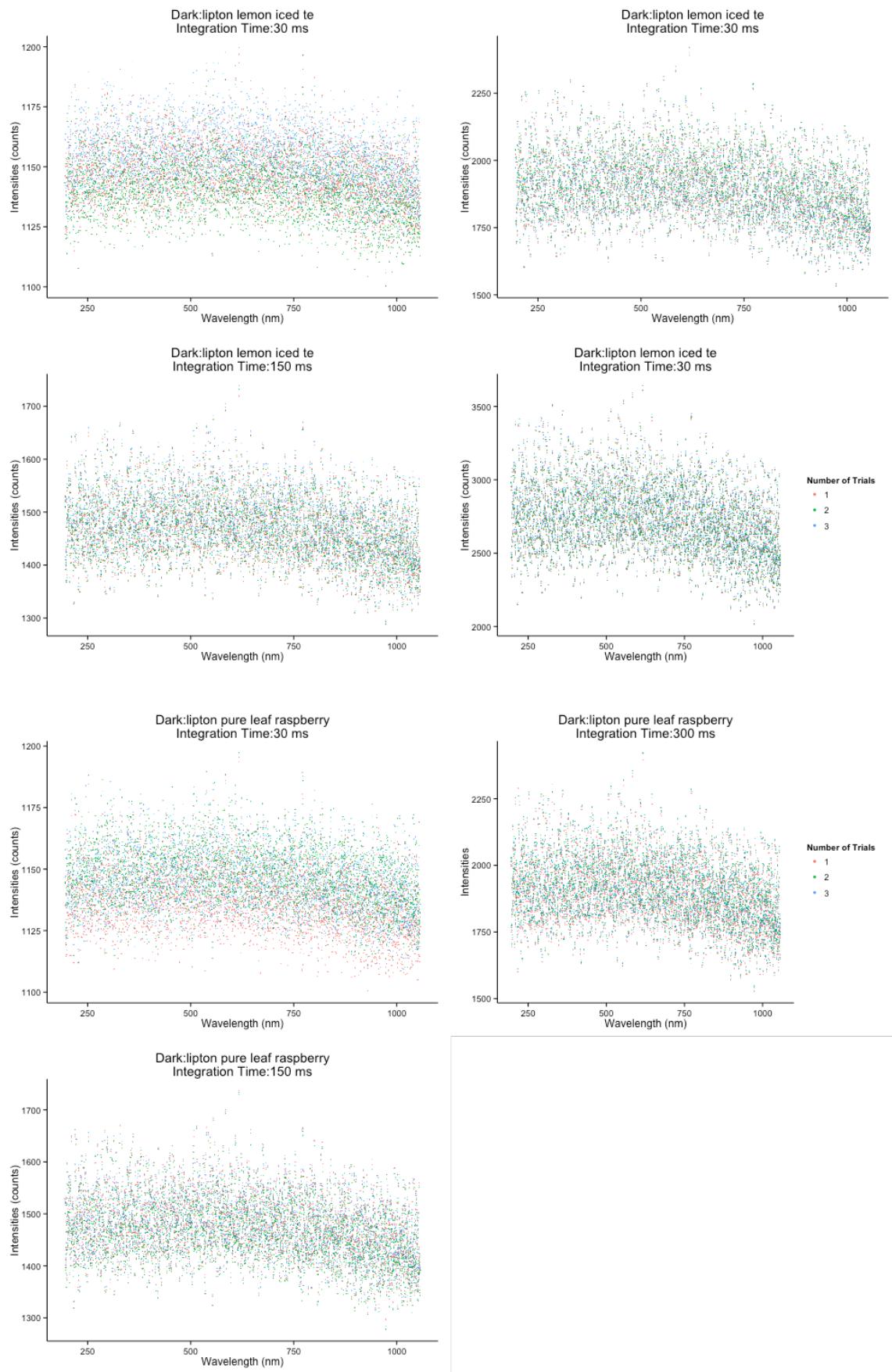


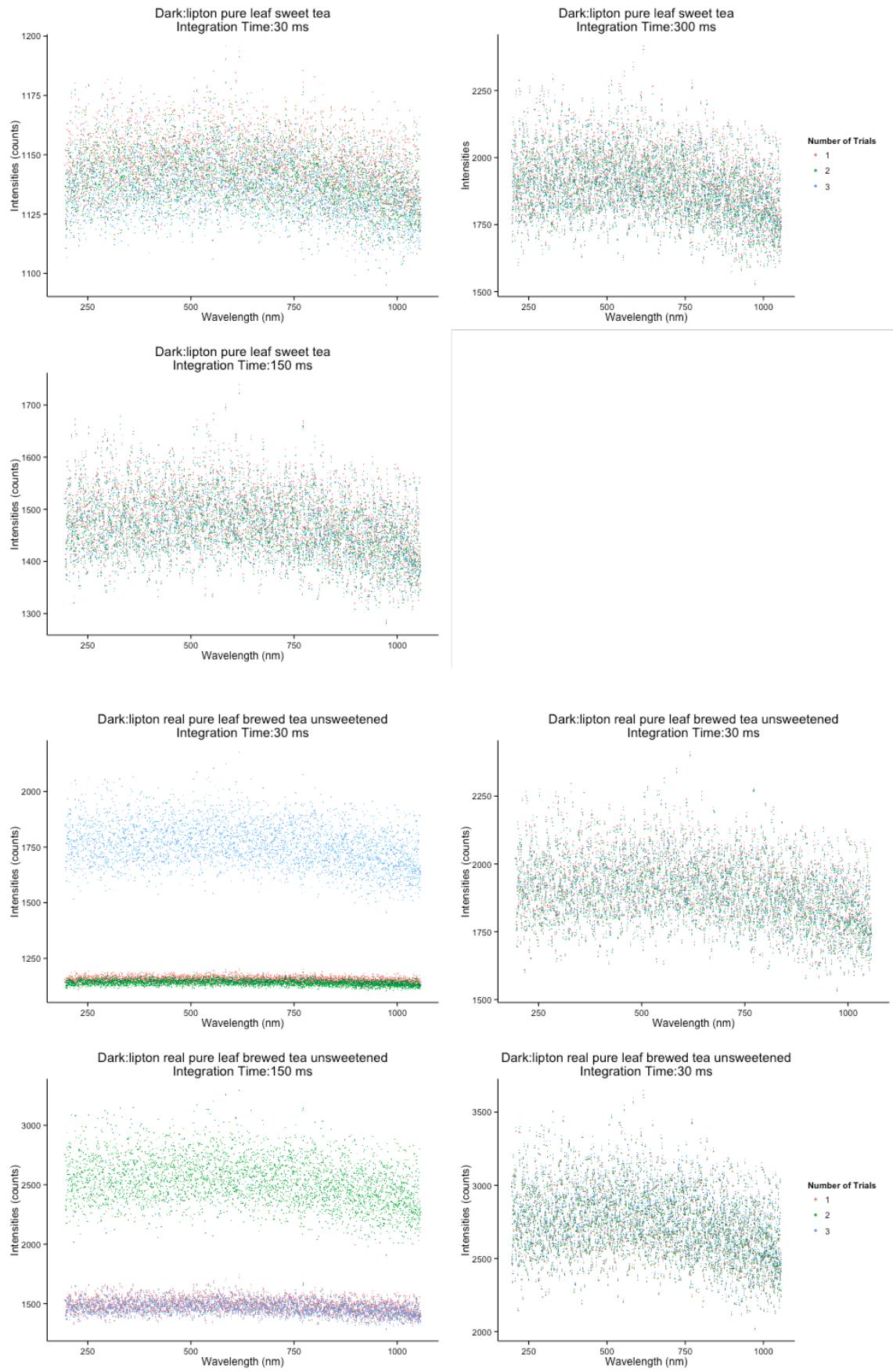


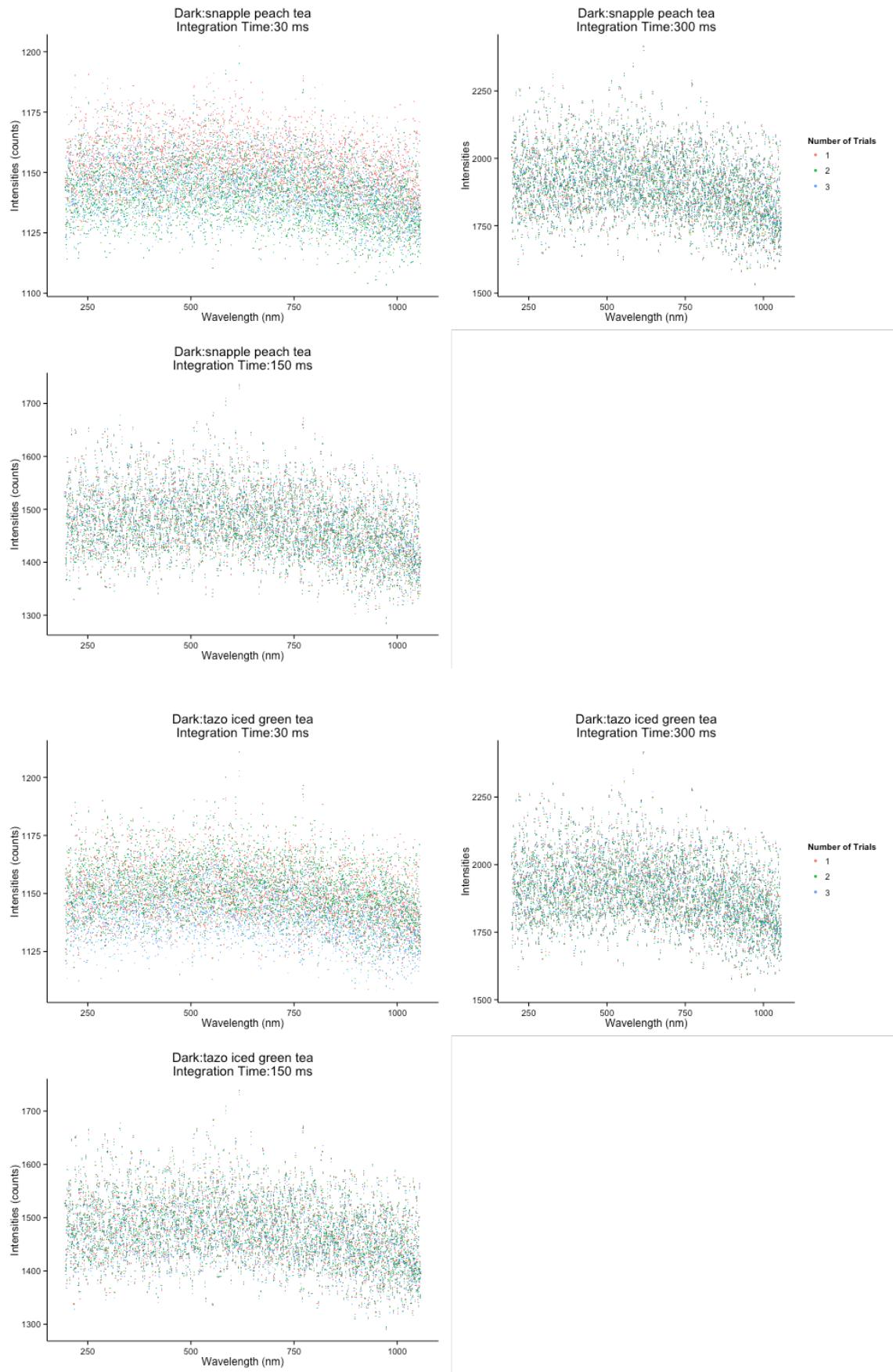




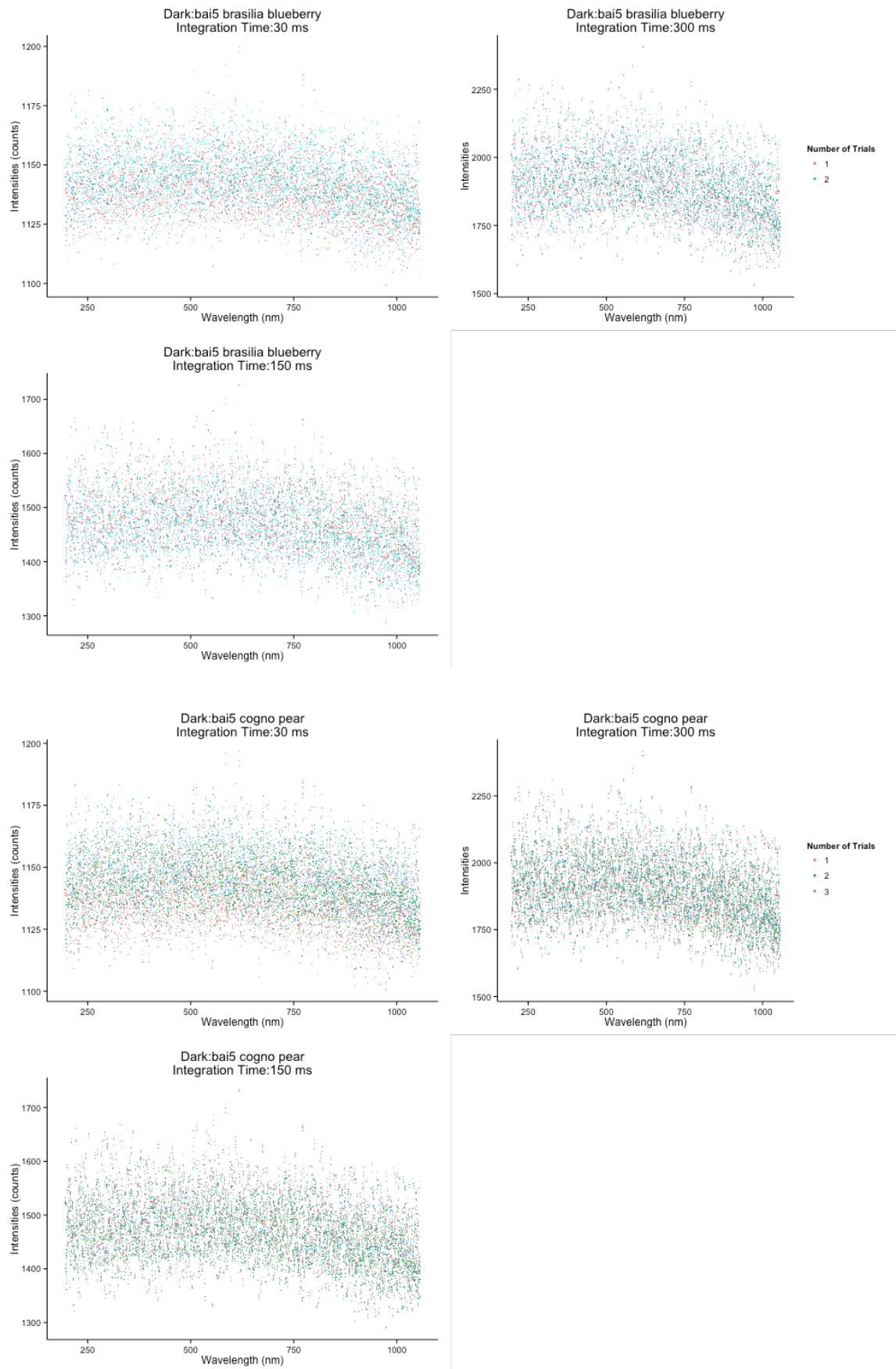


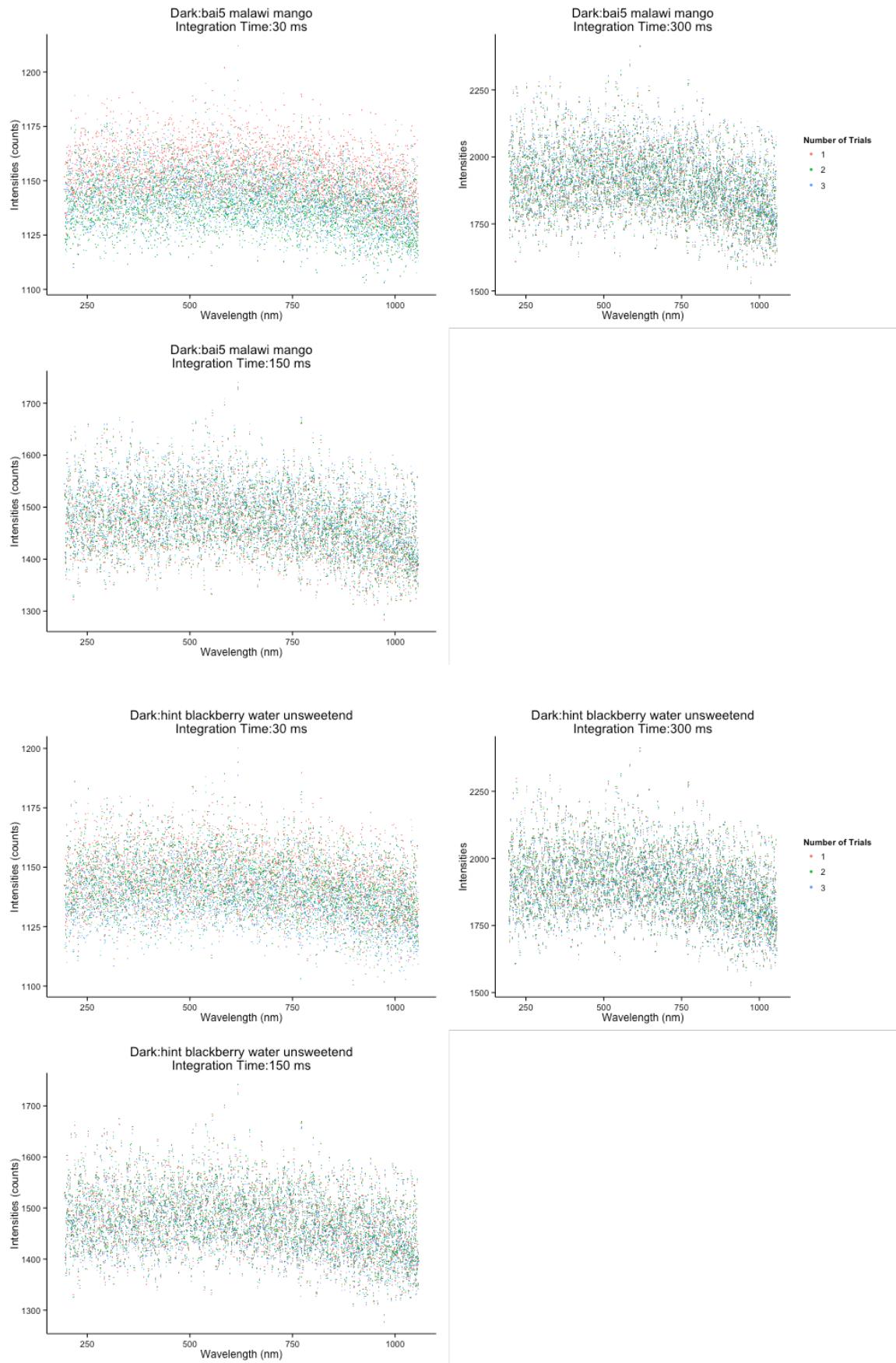


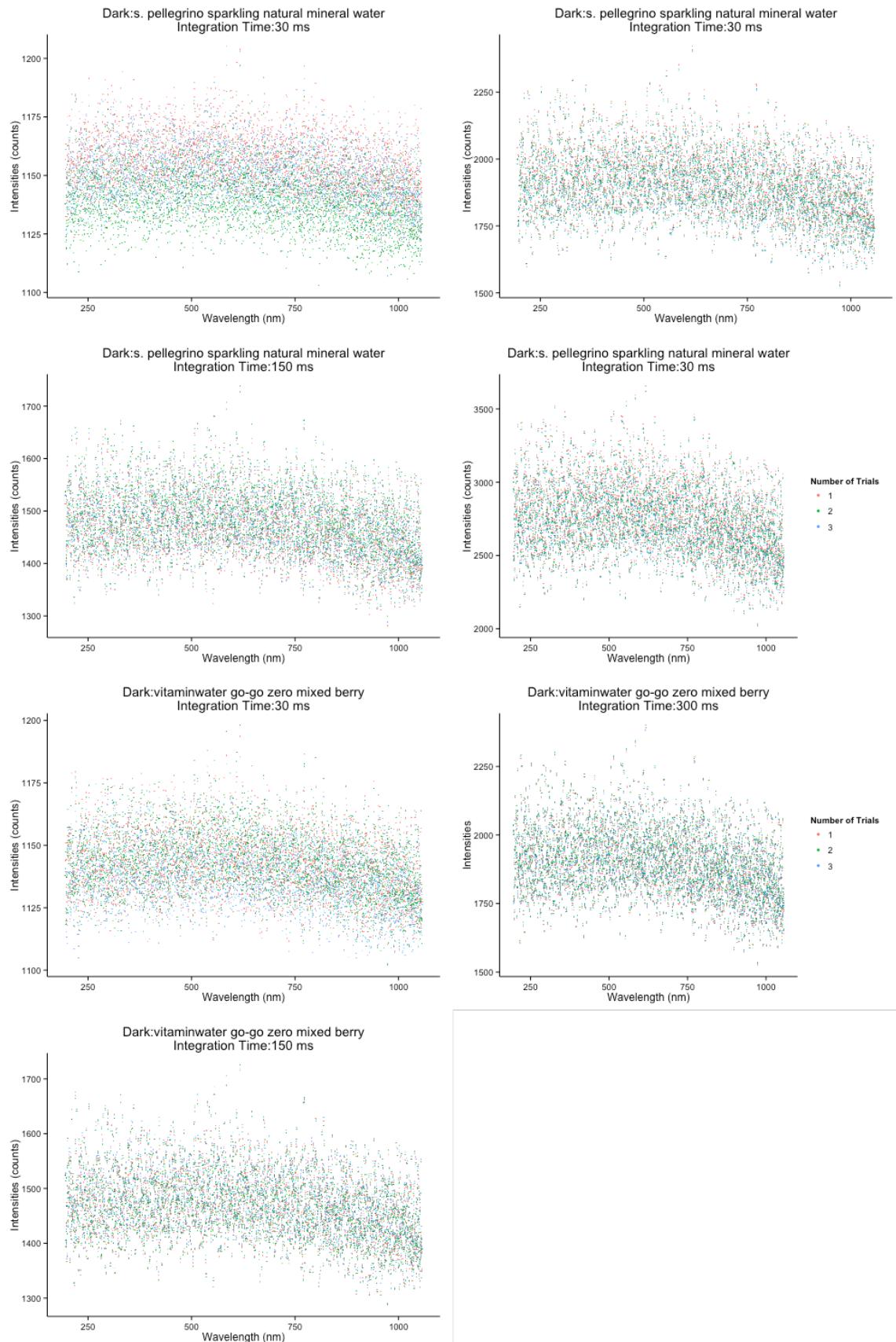


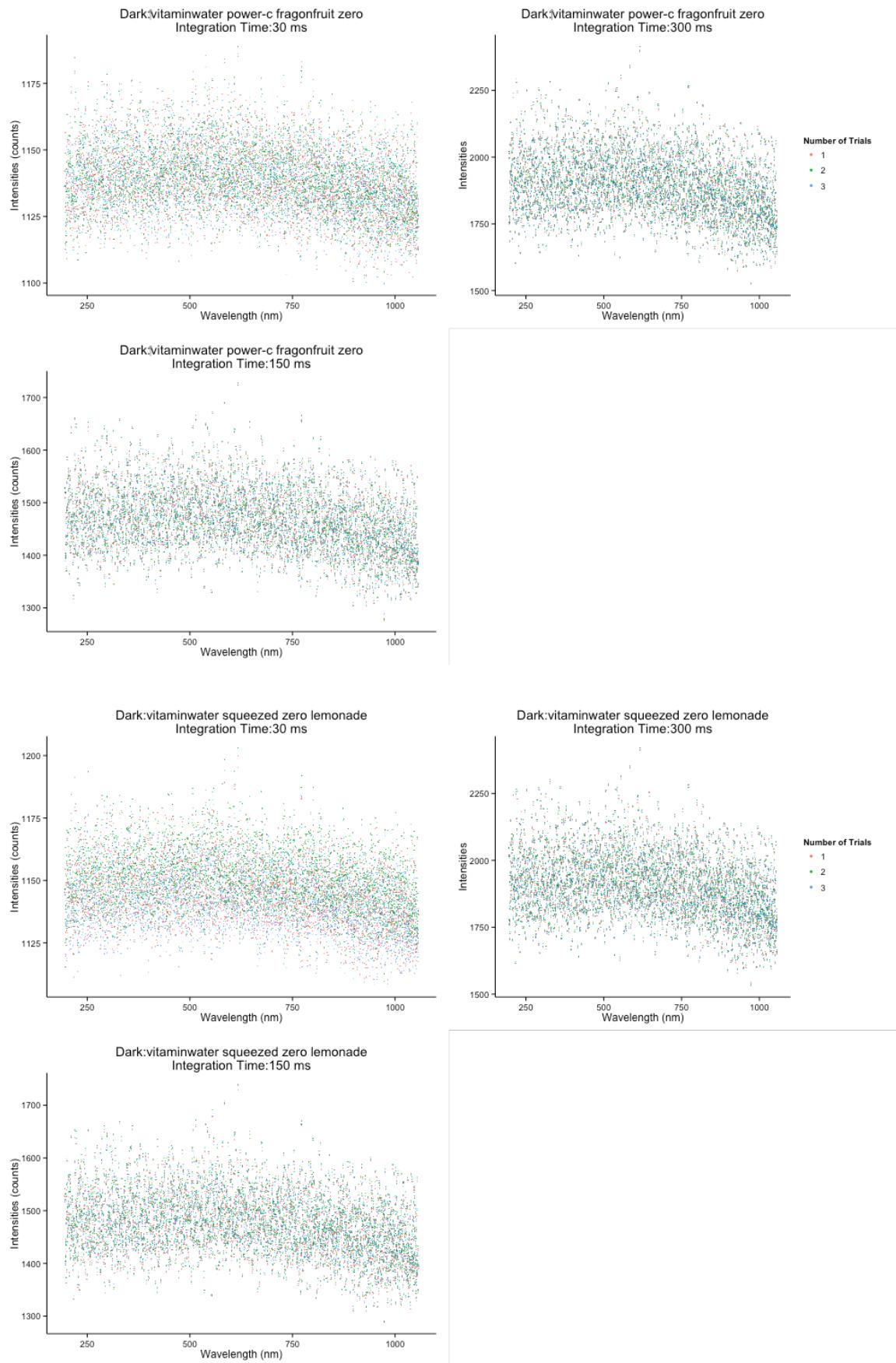


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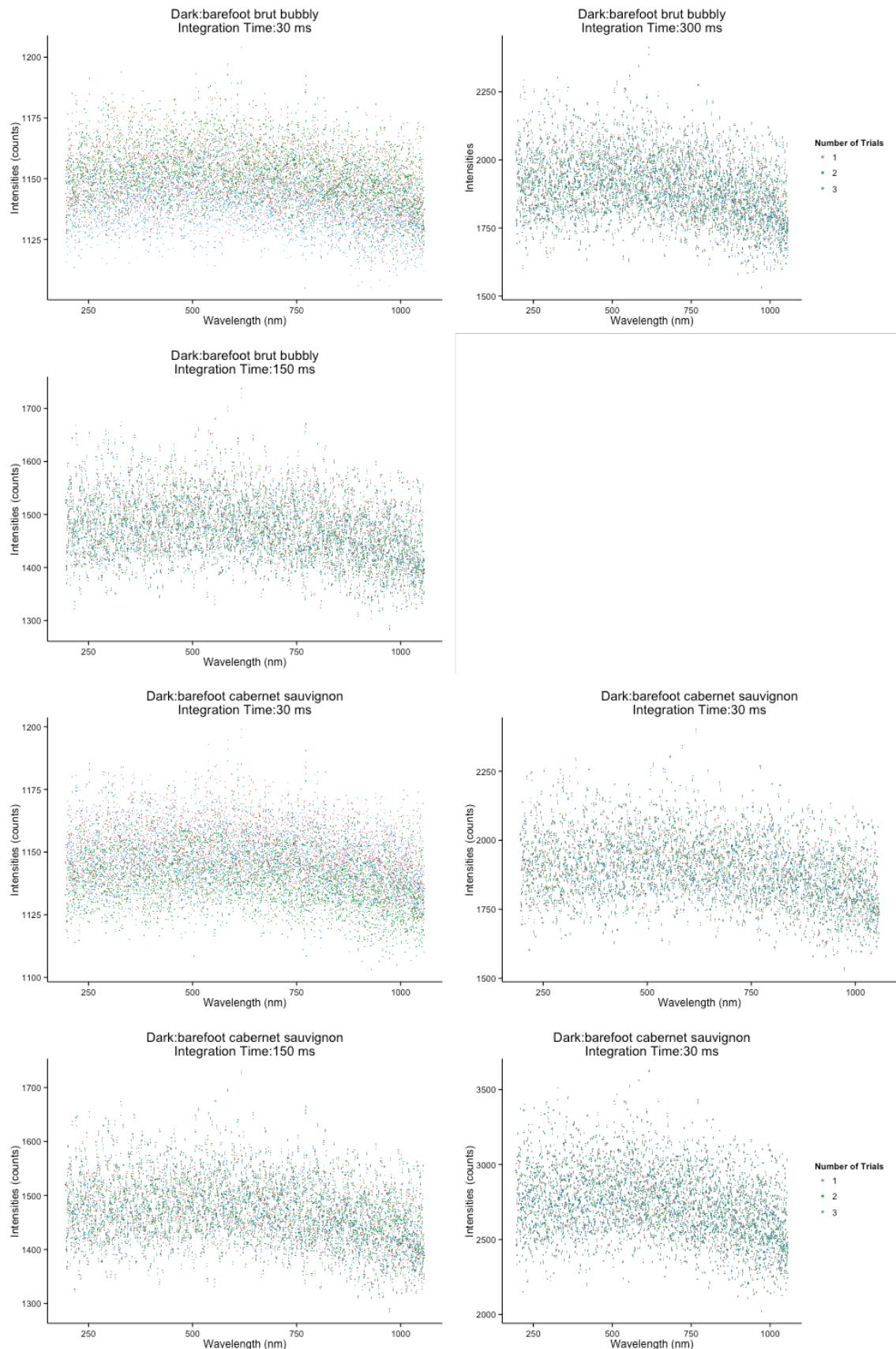


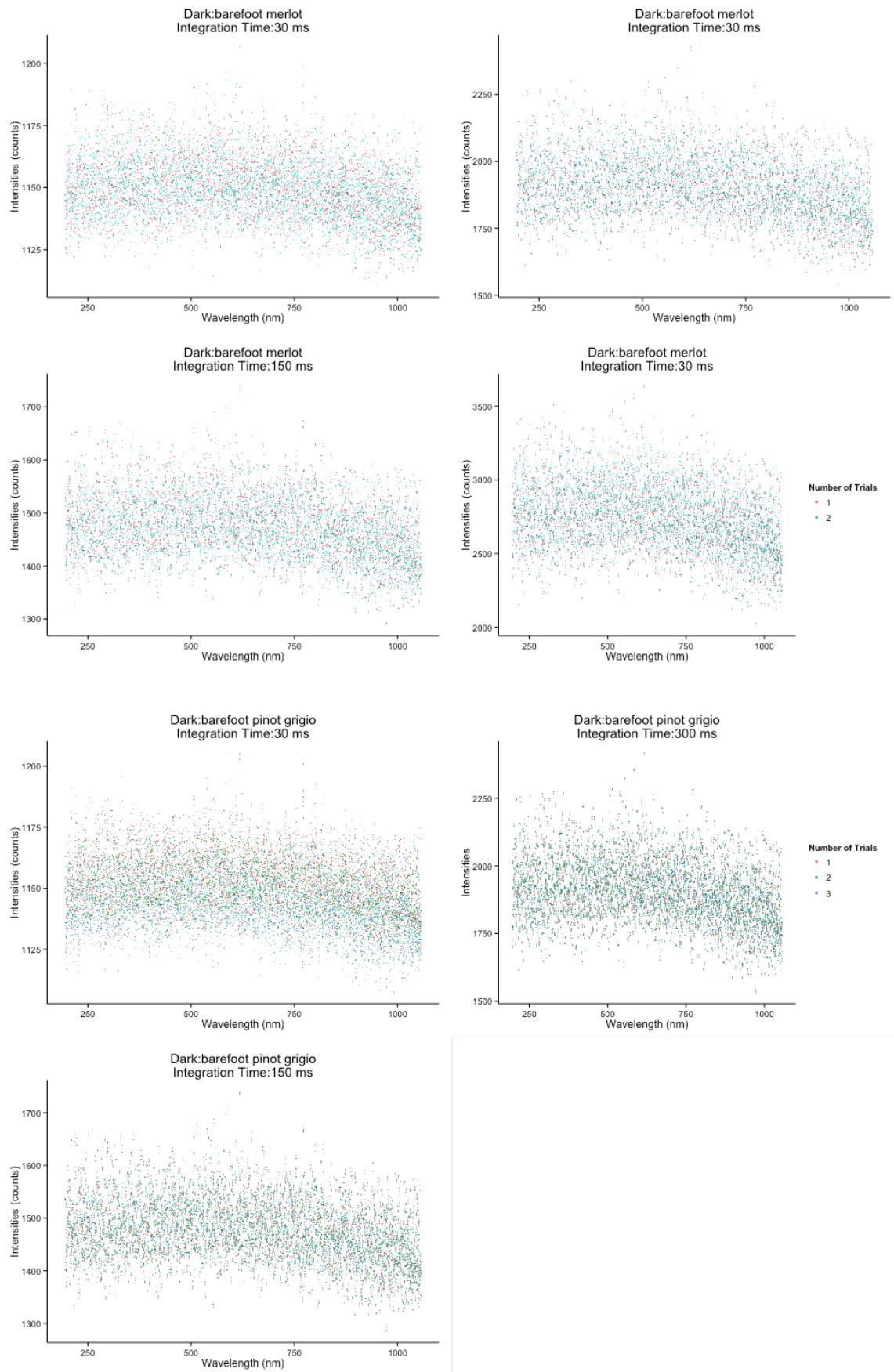


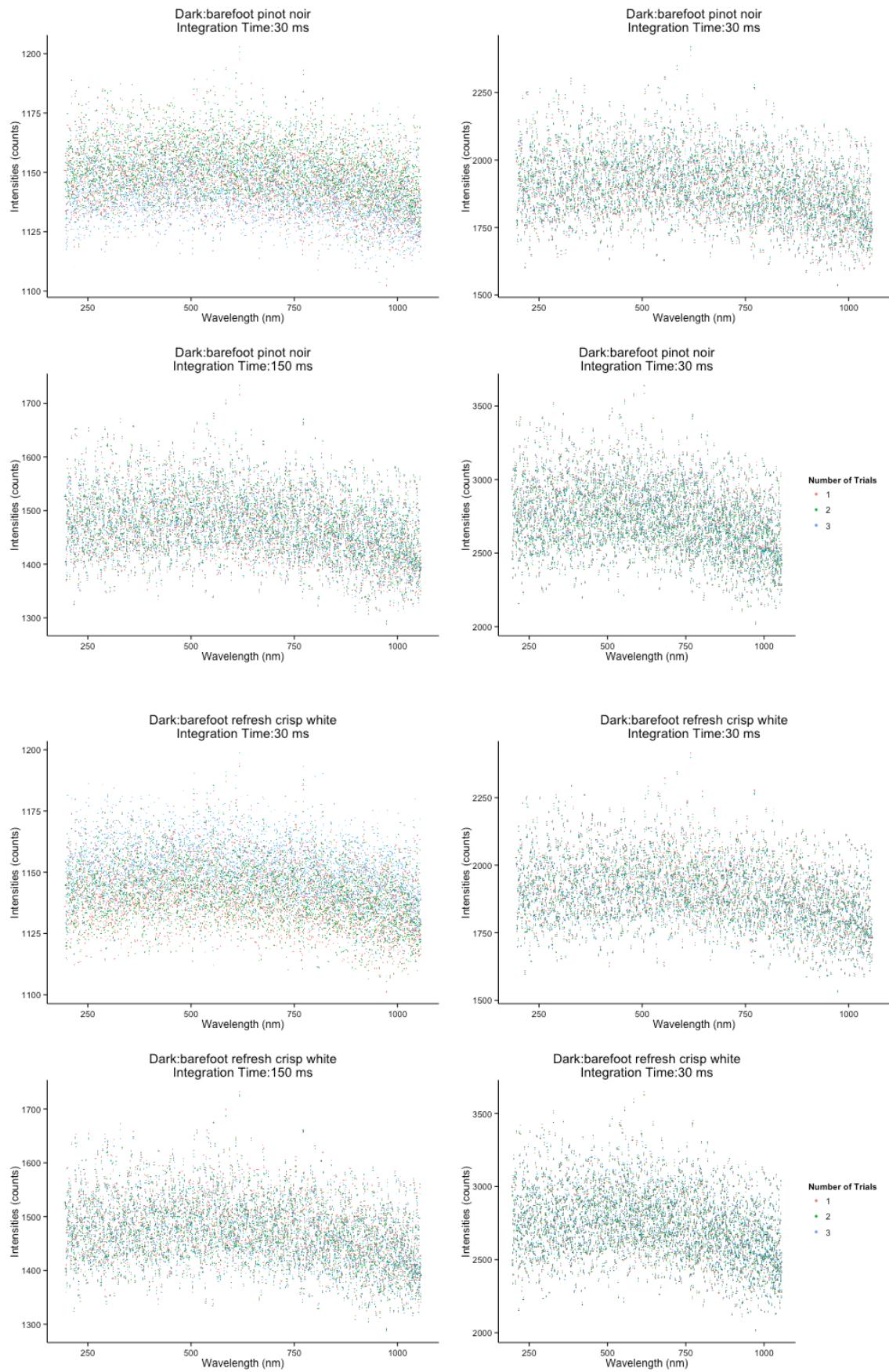


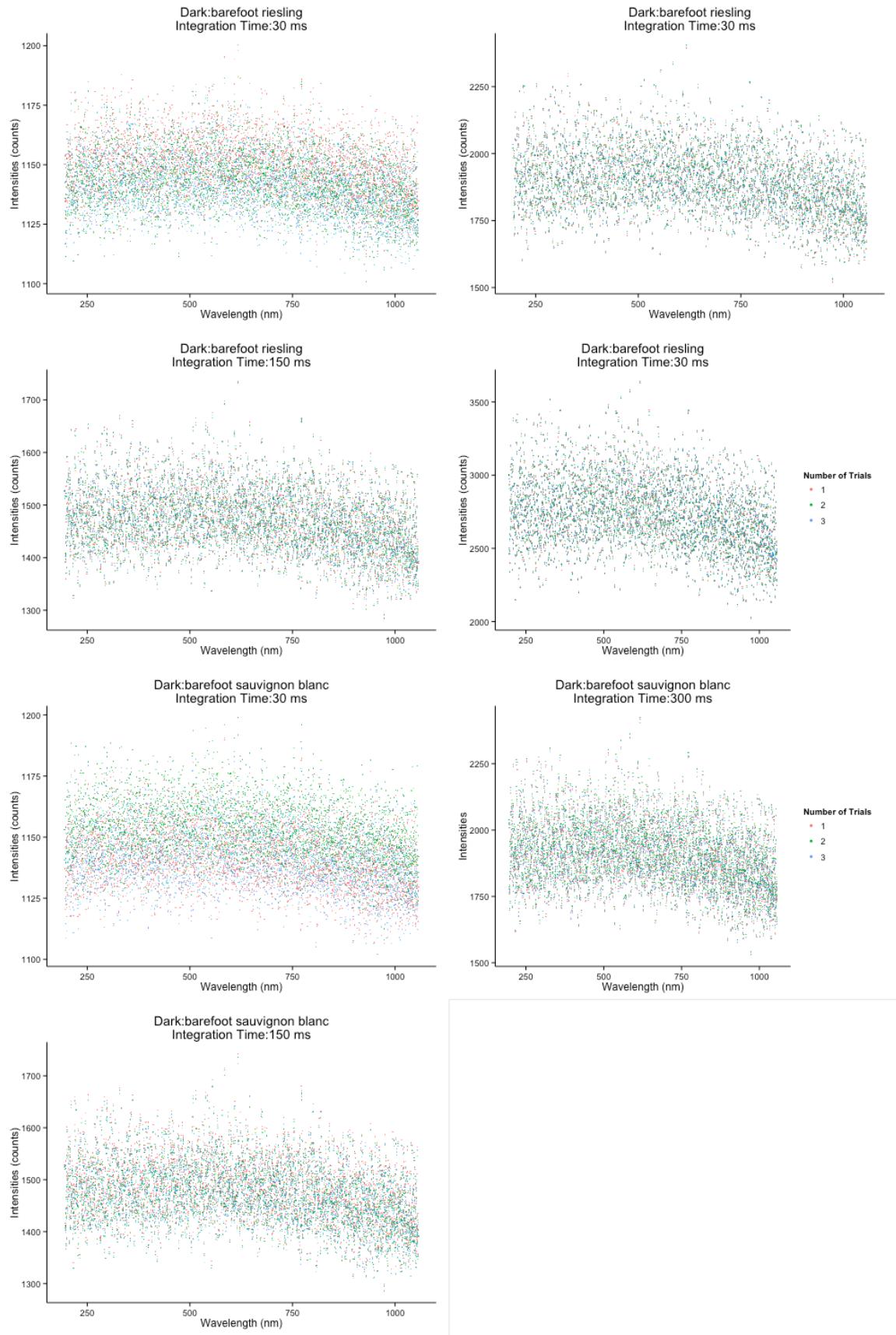


Wine:









Appendix E- 100 Drink List

Drink	Category
7-up	soda
A&W Rootbeer	soda
Arizona Lemon Tea	tea
Bacardi Rum Island Iced Tea	alcohol
Bai 5-Brasilia Blueberry	water
Bai 5-Congo Pear	water
Bai 5- Malawi Mango	water
Barefoot Brut Bubbly	wine
Barefoot Cabernet Sauvignon	wine
Barefoot Merlot	wine
Barefoot Pinot Grigio	wine
Barefoot Pinot Noire	wine
Barefoot Refresh Crisp White	wine
Barefoot Riesling	wine
Barefoot Sauvignon Blanc	wine
Becks	beer
Bud Light Lime	beer
Budweiser	beer
Caffeine Free Diet Coke	soda
Caprisun 100% Apple juice	juice
Caprisun Orange 25% less sugar	juice
Chum-Churum	alcohol
Clamato Tomato Juice	juice
Coca-Cola Classic	soda
Core Chocolate Protein Shake	other
Creamy Chocolate Fudge	other
Diet Lipton Green Tea Citrus	tea
Dos Equis Ambar	beer
Fresca Original Citrus	soda
FUZE Peach Mango	juice
Fuze slenderize strawberry	juice
Gatorade Cool Blue	sport
Gatorade Frost Glacier Cherry	sport
Gatorade Frost Riptide Rush	sport
Gatorade Fruit Punch low-calorie	sport
Gatorade G2 Orange	sport
Gin	alcohol
Guiness Extra Stout	beer
Heineken	beer
Heineken Light	beer

Hint Blackberry Water	water
Honest Tea Honey Green Tea	tea
Honest Tea Peach Tea	tea
Horizon Organic Chocolate Low fat Milk	milk
Horizon Organic Low Fat Milk	milk
Horizon Organic Strawberry Milk	milk
Horizon Organic Vanilla Milk	milk
Java Monster Mean Bean	energy
Kahlua	alcohol
Kahlua White Russian	alcohol
Lipton Lemon Ice Tea	tea
Lipton Pure Leaf Sweet Tea	tea
Lipton Pure Leaf Tea Unsweetened	tea
Lipton Pure Leaf Raspberry	tea
Lucerne Milk 1% fat	milk
Lucerne Milk 2% fat	milk
Lucerne Milk No fat	milk
Lucerne Milk Whole Milk	milk
Mamma Chia Guava mamma	other
Mamma Chia Organic Vitality Cherry Lime	other
Mamma Chia Squeeze Apple Cinnamon	other
Mamma Chia Squeeze Blackberry Bliss	other
Mamma Chia Squeeze Snack Mango Coconut	other
Michelob Ultra Light	beer
Minute Maid Fruit Punch	juice
Minute Maid Mixed Berry	juice
Minute Maid Orange Juice	juice
Monster Energy	energy
Monster Energy Absolutely Zero	energy
Monster Energy Lo-carb	energy
Monster Energy Rehab Tea+ Pink Lemonade	energy
Monster Energy Rehab Tea+Lemonade	energy
Mountain Dew	soda
Muscle Milk-Protein Shake, Chocolate	other
Ocean Spray Cranberry	juice
Orgain Creamy Chocolate Fudge	other
Pepsi	soda
Red Bull	energy
Red Bull Sugar Free	energy
Silk Soymilk	milk
Snapple Peach Tea	tea
Sparkling Natural Mineral Water	water
Sprite Lemon-lime	soda
Starbucks Coffee and Milk (Iced Coffee) vanilla	coffee

Starbucks Coffee and Milk (Iced Coffee)-Low Calorie	coffee
Starbucks Doubleshot Energy Mocha	coffee
Starbucks Doubleshot Energy Vanilla	coffee
Starbucks Doubleshot white chocolate	coffee
Starbucks Frappuccino Vanilla	coffee
Starbucks Frappuccino Vanilla Light	coffee
Starbucks Refreshers Raspberry Pomegranate	soda
Starbucks Refreshers Strawberry Lemonade	soda
Tazo Iced Green Tea	tea
Tequila	alcohol
V8 Original Vegetable Juice	juice
vitamin water go-go zero	water
Vitamin Water Power-C dragonfruit	water
Vitamin Water Squeezed Lemonade Zero	water
Whiskey	alcohol
Wolfschmidt Vodka	alcohol