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The Amount of Total Dissolved Solids in Coffee Made by 6 Different Brewing Methods

Sabrina Washington

ABSTRACT

Different brewing methods can have different effects on the quality of the coffee made. The three main variables that build the quality of coffee are strength, extraction, and the brew formula. The amount of total dissolved solids (TDS) in the brewed coffee determines the above three variables. In this experiment, six different brewing methods were utilized to determine the TDS levels after each method. America's average desired range of TDS is between 1.2-1.5% TDS in the coffee. This experiment showed that the standard drip method, having the highest amount of TDS, created brews with an average of 1.67% TDS, and the percolator method having the lowest amount of TDS in the brews with an average of 1.09% TDS. The six methods showed TDS levels that are significantly different from each other to be able to distinguish which of the methods used have the preferred amount of TDS levels.

Keywords: *coffee, total dissolved solids, brewing methods*

INTRODUCTION

Coffee, which is made various ways across the world, is one main component of America's daily lives. The way a person tends to like their coffee, style, taste, and temperature, mainly depends on the way their coffee is brewed out of the various methods across the world. All these methods differ due to the intensity of the amount of caffeine you may want in your cup of coffee, to the cost of brewing method, the easiest method, tradition, or the location that you are at. When it comes to the chemistry of coffee, the main component is caffeine In this experiment there will be 6 different brewing methods that will be tested out, to be able to establish the amounts of total dissolved solids from each brew (Lingle,T. 2015).

Although, there is no actual chemical composition of coffee, due to the fact that coffee is created in various ways, the main chemical component found in coffee is caffeine, with a chemical composition of C8H10N4O2. Since the most common reason for drinking coffee is to get a boost of energy, the amount of caffeine in the coffee is determined by the brewing method used. Some methods produce a high amount of caffeine, causing the coffee to have a "strong" taste, giving you that boost of energy by waking the body up (Hanson, Matthew. 2015). On the other hand some brewing methods can have low amounts of caffeine or can even be caffeine free. The most abundant phenolic compounds in coffee are chlorogenic acids (CGA's) which take up to 12% of the dry weight of unroasted coffee beans. When it comes to coffee having a bitter taste it is due to the chlorogenic acids, which also is the cause of heartburn and acid reflux disease. The structures of the CGA's that are left behind in the coffee after it is brewed are caffeoylquinic acids, feruloylquinic acids, and p-coumaroylquinicacids (Farah, Adriana and Carmen Marino Donangelo. 2006).

Coffee is mainly made up of polysaccharides, a type of carbohydrate which can cause weight gain if too much coffee is consumed and lipids, made up of oils and fats, which are water insoluble, so most of the lipids end up in the brewed coffee (Farah, Adriana and Carmen Marino Donangelo. 2006).

There are three main variables strength, extraction, and the brew formula, in coffee which affect the aromas, taste, and the body of the coffee. (Davies, Emma.May2011).

The main goal of this experiment is to determine the amount of total dissolved solids (TDS) and their components depending on the type of brewing method that was used. TDS can be used to indicate the strength of the brew; since it is directly associated with the efficiency of the extraction of the coffee after it is brewed. When the TDS of the brewed coffee is below 75mg/L it means the coffee is under extracted, and when the TDS is above 250mg/L the coffee is overly extracted, which is usually due to the highly absorption of the soluble coffee solids. The typically wanted value of TDS in coffee for America is a range between a TDS measurement of 1.2-1.5%, which is 12-15mg/L (Mussatto, Solange, 2011).

There are 6 different brewing methods that were chose for this experiment, French press, Percolator, Standard Drip, Chemex, Cold Brew, and the Cowboy Method. The French press usually comes out very dense and heavy, giving the "chalky" taste; however, when French press is prepared well it is actually the purest compared to all the coffee brewing methods, but it can be easily overextracted. . The percolator is a type of coffee brewing machine and in this process the coffee is brewed by the water being cycled over and over causing the water to reach a higher temperature each time it passes through the coffee grounds, so the coffee is usually strong since it is

basically brewed multiple times. The standard drip method is the most commonly used brewing machine, because it is the most simple and cleanest way to brew coffee in the home. The Chemex method is very similar to the standard drip method with just a couple more steps in the process.

The cold brew is similar to the French press method, except cold water is used instead of hot water, interestingly cold water brings out the natural flavors in coffee's oils that hot water typically tends to chemically alter or completely dissolve which is a good benefit for those that suffer heart burn or acid reflux disease. Naturally created by outdoor campers is the Cowboy method, which is the only method that involves using whole coffee beans. Since nothing is filtered in this process, the coffee is filled with many natural oils and acids from the coffee beans, which is not good in the health of the human body. In this experiment the amount of TDS in each sample of coffee was determined by using different brewing methods (Kassien, Lauren. 2015).

MATERIALS AND METHODS

Coffee obtained from Craft Coffee of McPherson, KS., was used for the study. Six brewing methods were utilized in the experiment, French press, standard drip, percolator, cowboy, chemex, and cold brew. Majority of the coffee was ground to a # 3 ½, with standard settings of # 5 being the course ground and a # ½ being the finest ground, the beans that weren't ground were used for the cowboy method. The same coffee was used in every method and each method was done with 15g of coffee and 250mL of distilled deionized water. Each method was repeated 8 times and from each cup brewed, three 10 ml samples were tested.

French press method: 250 mL of boiling distilled deionized water was poured on to 15 g of coffee grounds. It was gently stirred and let bloom for 30 seconds. The lid was placed on the coffee machine and let steep for 4 minutes. Then the filter was pressed down and the coffee was collected in a 250 ml container and was covered with Para film immediately.

Standard Drip method: 250mL of distilled deionized water was poured into the "standard drip machine" along with 15g of ground coffee. The start button was then pushed for the coffee to brew for 9 minutes, and collected into a 250mL container that was immediately covered with Para film.

Chemex method: 10mL of boiling distilled deionized water was poured through filter paper into a glass container to set for 1 minute to warm the container. This water was then disposed of, and 15g of ground coffee was placed into the filter paper, and 250 ml of boiling distilled deionized water was poured into it in a circular motion. The complete pouring process took 4 minutes, and the coffee was filtered into a 250mL container and immediately covered with Para film.

Cold Brew Method: 250mL of distilled deionized room temperature water was poured over 15g of ground coffee in a container that set for 12 hours. The filtered coffee was placed into a 250mL container and immediately covered with Para film.

Cowboy method: 15g of whole coffee beans and 250mL distilled deionized water were placed in a container to boil on a hot burner for 20minutes. A splash of cold water was then added, and the coffee was filtered into a 250mL container that was immediately covered with Para film.

Percolator method: 250mL of distilled deionized water and 15g of ground coffee was placed into the "percolator machine" and the button for heat was then turned on to brew the coffee for 6 minutes. The filtered coffee was then transferred into a 250mL container and covered with Para film immediately.

Oven Dehydration method: To measure the amount of total dissolved solids, a 10mL sample was taken from each container with the brewed coffee. And was placed in a cleaned, oven dried and pre-weighted crucible. The crucible was then placed in a110°C oven for 22hours. Then it was removed from the oven and placed in a desiccator until it cooled down to room temperature. Then the crucible was reweighed to determine the amount of TDS left from the sample.

This process was repeated for each brewing method (6 brews x 8 replicates x 3 samples) to get a total of 144 measurements.

After the weighing was done, an average of the amount of total dissolved solids was found for each brewing method.

RESULTS

StandardDrip(0.16658g),ColdBrew(0.16557),FrenchPress(0.14633),Cowboy(0.139125),Chemex(0.12735), Percolator(0.10865). Some of the amounts of total dissolved solids from each method were similar and some were extremely different. Overall it went well and an answer of which brew has the most total dissolved solids in each brew was discovered. Figure 1 illustrates the differences in the amounts of TDS obtained from the different brewing methods, all showing a significant difference except for the standard drip and cold brew methods. Table 1 shows the average percentage of TDS which is compared to America's average desired amount of TDS in coffee.

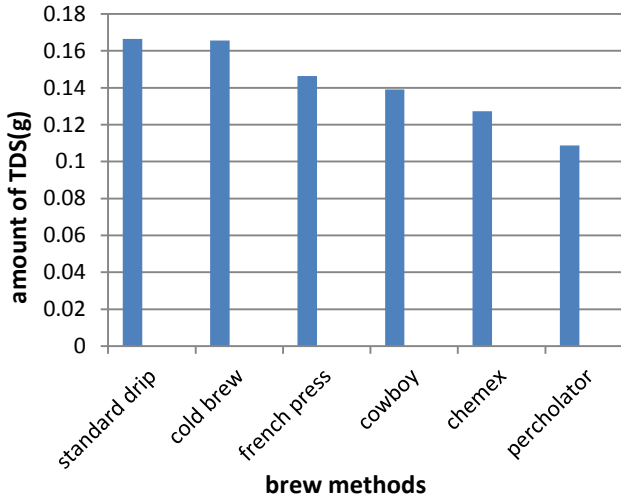

Figure 1: The average amount of TDS for each method.

Table 1: The average amount and percentage of TDS from each brew.

Brew method	Average TDS	% of TDS
Standard drip	0.16658g	1.67%
Cold brew	0.16557g	1.66%
French press	0.14633g	1.46%
cowboy	0.13912g	1.39%
chemex	0.12735g	1.27%
percolator	0.10865g	1.09%

DISCUSSION

The main factor that decides the flavor in coffee is the amount of total dissolved solids (TDS) that is left in coffee after it is brewed. Since there are numerous ways to brew coffee, it is important to be able to distinguish the differences between the different types of brews, by determining which are the best types of methods that can provide the desired coffee. America's typically desired coffee has an average of TDS between 1.2-1.5% of total dissolved solids left after each brew. In the experiment each brew gave results that showed a significant difference in the amount of TDS left after each brew (figure 1). I was expected that the percentages of TDS may not be extremely different, but it was desired to get percentages that were spread out enough to be able differentiate the different methods (figure 2). All methods provided spread out percentages; French press 1.46%,cowboy 1.39%, chemex 1.27%, except for the standard drip 1.67% and cold brew 1.66% methods were extremely close. The percolator provided a very low amount of TDS, 0.10865 (1.09%), that typically wouldn't be desired to drink. Overall, the experiment was successful in differentiating the amounts of total dissolved solids in each brew of different brews. The way coffee is brewed plays the most important role on how a person desires there coffee to be produced, determining these average values helps determine which type of brew is mainly preferred.

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