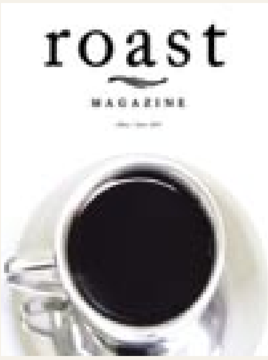

Gaining Ground

What You Should Know About Grinding Coffee

by Daniel Ephraim

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WHEN WE SAVOR a fine cup of coffee, the quality of the beverage is a manifestation of a series of events that began with the green coffee bean and ended with a fine cup of java. However, if an upset or failure occurs at any stage of the process, then the quality of the coffee brew, and the joy it engenders, could be adversely impacted.

After the proper cultivation, processing, transporting and warehousing of the coffee bean, two transformative events take place. First is the roasting, wherein the development of the coffee bean is monitored, evaluated and controlled to reach the optimal roast profile.

The second is grinding, which is sometimes referred to as the "Rodney Dangerfield" of coffee processes—it just doesn't get much respect! However, coffee quality is every bit as critical through the grinding process and should be monitored, evaluated and controlled to the same degree as roasting.

Improper coffee grinding, being one of the last links in the coffee processing chain, is the most costly, since not only the commodity, or green coffee cost, might be compromised, but the entirety of the value added that has occurred, as represented by each portion in the series of "upstream" processes, might be compromised, or lost, as well.

As an industry, we are fortunate to have a tool that defines the symptoms, if not the causes, of poor coffee grinding. This is shown by the "Gold Cup" Standard chart (Fig. 1, pg. 2). However, we need to examine not only the symptoms of poor coffee grinding and preparation, but also the causes that relate directly to the grind mechanics, or particle distribution, that composes a good coffee grind.

The key word, or "center of the universe," in coffee grinding is extraction, or more correctly: proper extraction. The "planets" revolving around the extraction "sun" are particle size and particle uniformity. The only way to convert a roasted coffee bean into a brew is to extract the soluble solids from each bean into the water through the extraction process. Complications arise because each particle size extracts those soluble solids (SS) at a different rate. For instance, as shown in Fig. 2 on pg. 3, a particle size that extracts 20 percent of the soluble solids (an ideal amount) in a drip brewer at four minutes should extract the same amount in an espresso brewer at 25 seconds. Furthermore, a proper drip fine grind (720um) might extract only 10 percent soluble solids if used in an espresso brewer and more than 30 percent if used in a urn-type brewer (Fig. 3, pg. 3).

Obviously, this is an extreme example, and most folks would adjust their grind in such a case. However, a grind that has elements of both a fine and coarse grind in the same sample is commonplace and results in a reduction of

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quality, as defined by brew quality and taste. There are two key elements that drive the principle of brewed solids for extraction in coffee grinding:

■ First is the amount of soluble solids extracted from the coffee bean, with 20 percent being the "holy grail."

■ Second is the amount of soluble solids that are in the coffee brew itself, as a percentage, which is a function of the amount of coffee used for the brew and the extraction rate.

In the first element, extraction rate, coffee is composed of many different elements, with the soluble solids element being the basis for what might be called the essence of the coffee brew. We can't drink the brew that would be extracted from whole coffee beans. In fact, if we did, we would have a light tea that would represent an extraction rate of, maybe, one percent of the available solids in the roasted coffee bean. So the key, as shown in Fig. 1, is to extract a given amount of the soluble solids that represents the best in the coffee. This percentage has been determined to be 18 to 22 percent. If we extract less than this, the brew will be weak and underdeveloped, while the brew from above this percentage will be bitter in taste.

In the second extraction element, brewed solids in the coffee solution, even if the coffee extraction rate of the bean is correct at, say, 20 percent, the amount of ground coffee utilized for brewing also needs to be correct, since too little or too much ground coffee would result in a "weak" or "strong" taste, respectively (Fig. 1, this page). The brackets for describing the end result of these limits is 1.15 to 1.35 percent brewed soluble solids as a percentage of the brewed coffee. We need to reach the optimum balance between both sides of the equation.

To summarize, the two basic elements of proper extraction are proper grinding and proper ground coffee quantities. Determining the latter is merely an exercise in weighing and utilizing the proper amount. Consequently, the only remaining variable is grinding.

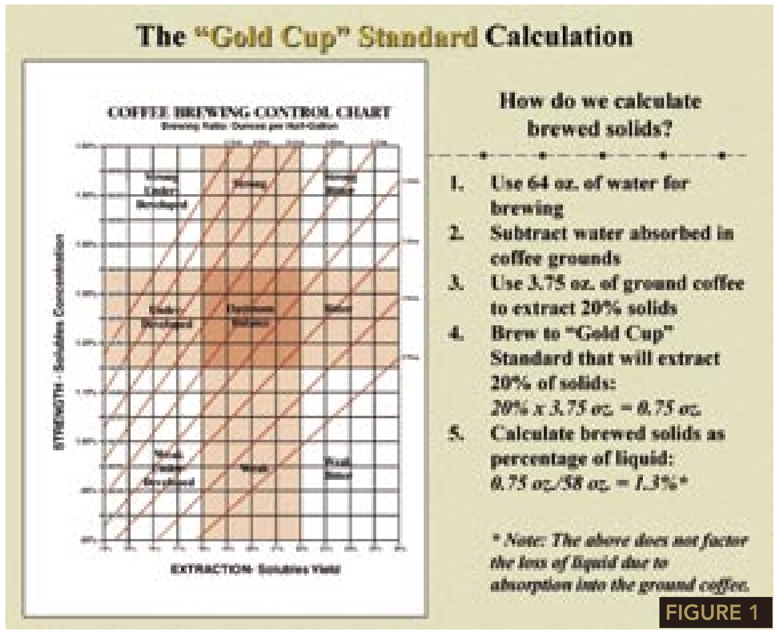

FIGURE 1

Earlier, we said that the "planets" around the extraction "sun" are particle size and particle uniformity. The necessity for these elements is based on the fact that coffee extraction is a function of the exposed surface area of the ground coffee.

This sounds simple since it makes sense that the more surface area of the ground coffee bean that is exposed to hot water, the greater the extraction. So how do we get this to reach the ideal 20 percent? If we look at Fig. 4 (pg. 4), we see that as coffee is ground finer and finer, the surface area increases. This is due to the geometrical expansion of surface area with the reduction in particle size, as shown in Fig. 5 (pg. 4).

Sounds simple, except that every brewing method has a different ideal exposed surface area factor to achieve that 20 percent extraction rate. This is a result of each coffee brewing method extracting ground coffee at a different rate. For instance, espresso will extract 20 percent solids in 25 seconds, while a drip grind may extract 20 percent in 3.5 minutes.

Earlier, we defined exposed surface area as the critical factor in extraction, but we need to understand that the required amount of surface area exposed—expressed as cm^2/gm—is different for each brewing method. For instance, a particular drip coffee grind might have 62 cm^2/gm as an ideal to reach the 20 percent extraction level. To achieve that same level of extraction, an espresso brewer might require an exposed surface area of 130 cm^2/gm to achieve that same 20 percent level in 25 seconds.

So much for the "all-purpose grind" theory! Based upon the above, it's easy to see that the only way to achieve the desired amount of brewed soluble solids in the coffee beverage, with the same grind, is to vary the amount of coffee used to brew that

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coffee. For example, if a grind suitable for a particular brew method requires 62 cm²/gm surface area, but a coarser grind is utilized which offers only an 45 cm²/gm surface area, then 4.5 ounces of ground coffee will have to be utilized to achieve the desired brew solids level of, say, 1.2 percent. But now, if we look at the gold cup standard (Fig. 1, pg. 2), guess what? We see that compensating for a bad grind with more ground coffee results in a strong, underdeveloped taste profile. Essentially, the cost per cup is high and the quality is low.

The cost of a poor grind can be put into dollar and cents terms, as shown by (Fig. 6, pg. 4). We all are "wired" to the cost of a particular green coffee that might reflect a certain higher quality level. Maybe that number is $0.10/lb, or even $1.00/lb. In any case, we are likely to pay a premium for that extra green coffee quality. Now, if we look at the deleterious impact of a poor grind on the ultimate coffee brew and conservatively estimate such a cost at, say, 5 percent, then the comparable cost per pound, in an adverse quality impact, might be $0.10–$0.50/lb. Wow, that's a lot. And guess what? The cost of achieving a quality grind is typically well below $0.01/lb.

If we look at the accompanying cost-benefit analysis (Fig. 6) for green coffee types vs. grind quality, we see that there is, literally, no comparison. As shown by the graph, coffee grinding cannot improve the taste of the coffee, but rather only reduce it.

The discussion so far has revolved around what we have called a poor grind, which should be more accurately called either an incorrect grind (for a particular application) or, more onerous, a non-uniform grind, which has the characteristic of a broad range of particle sizes that are not good for any brewing method (Fig. 7, pg. 4). Sometimes this is referred to as a "dirty grind."

It is a credit to the resiliency of our product, coffee, that it has withstood many "assaults" on its quality within the processing cycle from green to brew. However, every little bit hurts, and a poor grind fit or quality due to non-uniformity will result in a reduction of final brewed coffee quality. This is analogous to substituting lower versus higher quality green coffee components in a blend.

So, that brings us to the important question: How do we achieve good coffee grind quality?

FIGURE 2

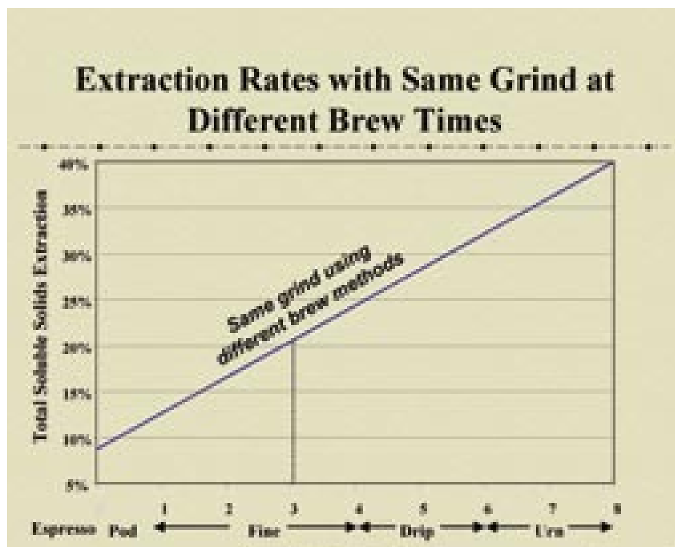

FIGURE 3

First, there is no substitute for good grinding equipment if it is maintained well. Whether it be a point-of-sale grinder (which might have inherent grind disadvantages such as lack of grind uniformity but the advantage of lower cost and ease of use), or the larger, commercial-type roller mills, these investments pay off rapidly in coffee-quality benefits.

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Second, we need to determine the optimal surface area for a particular brewing method. It is somewhat easier to do this if the brewing equipment is known, controlled or provided to the customer. In those cases, simply measuring brewed soluble solids by utilizing a soluble solids tester will determine the propriety of a grind, assuming all other factors are proper (including the ground coffee weight being used, the brewer being properly adjusted, etc.). Once this is determined, the grind is measured using either a sieve shaker or laser method and, after factoring in some variance due to normal grinding practices, your standard is established.

The above process is, essentially, the same as that performed by baristas when they adjust the espresso grinder throughout the day based upon how the brewer is performing. While this is an immediate, visual measure of grind quality, it is really no different than establishing the proper grind for any brewing method. It's just that we don't see the results as vividly as we do with an espresso brewer. However, it stands to reason that, if one method is important, aren't they all?

Third, we need to establish a standard for acceptable, or unacceptable, grind uniformity. As mentioned, different grinders have different capabilities in this regard, and the industry and SCAA grind standards are as good a place to start as any.

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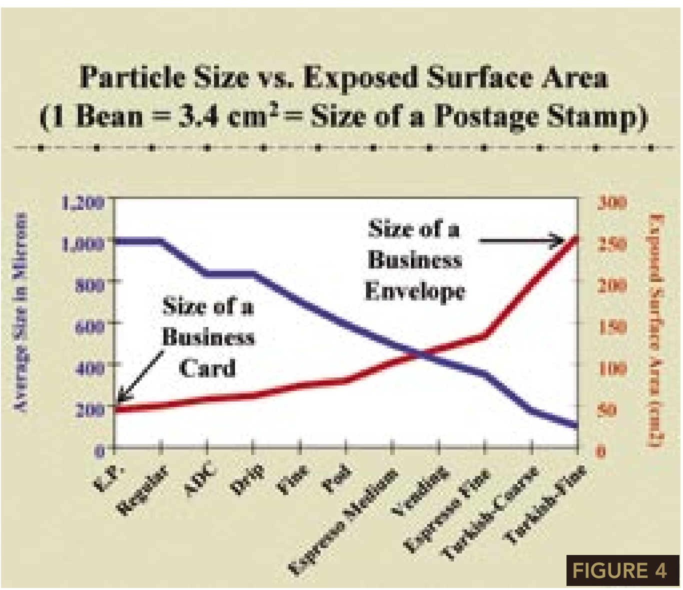

FIGURE 4

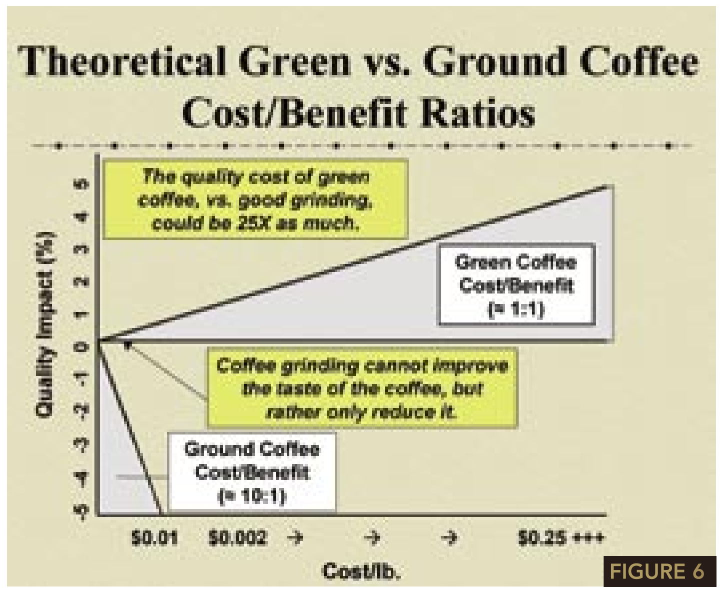

FIGURE 6

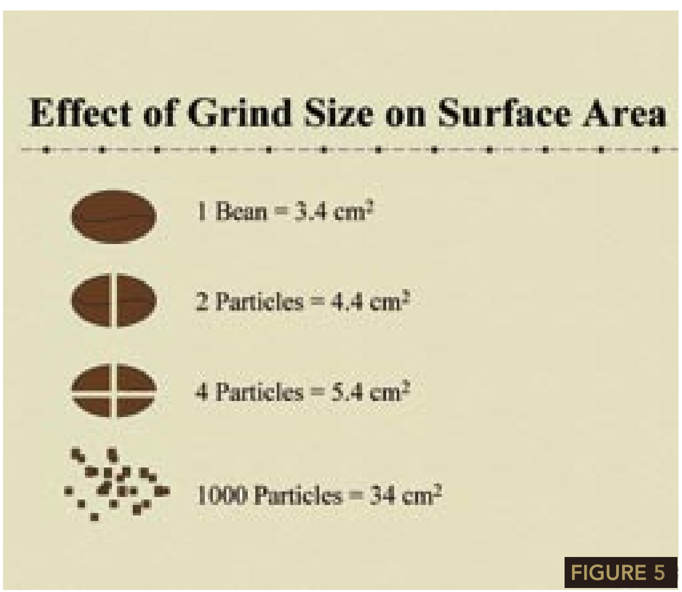

FIGURE 5

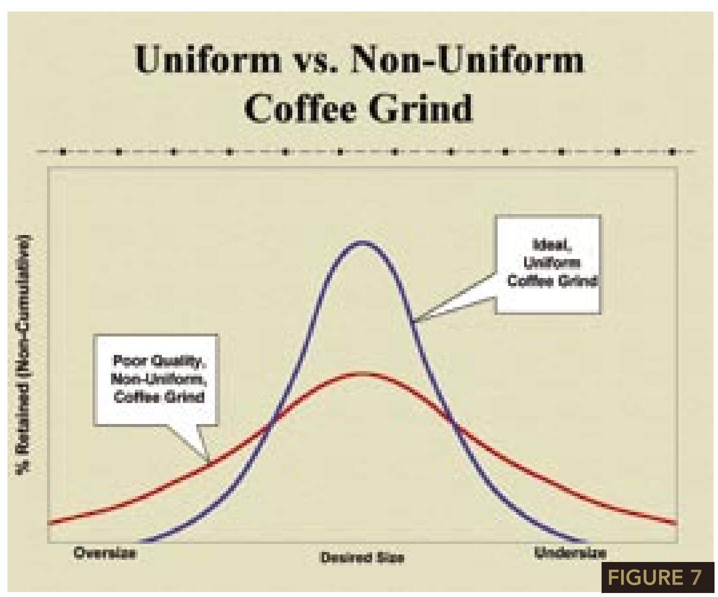

FIGURE 7

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Characteristically, the biggest factor in grind deterioration is wear—for the simple reason that wear on grinder parts, which is inevitable, is similar to the wear on the tires of your car. You can always go one more mile, but the risk factors multiply just like they do with a poor quality grind. The accompanying chart (Fig. 8, shown right) shows the actual results from two grinds that have the same average particle size but different uniformities (to the extent of rendering one inferior).

The key to good coffee brewing is good coffee grinding, which is obtained by optimizing the extraction of the soluble solids into the hot brewing water. This is determined by properly sizing the coffee grind and producing a particle distribution that is the most uniform possible. This combination will guarantee that coffee quality coming from the brewer will be equal to the coffee going into the brewer.

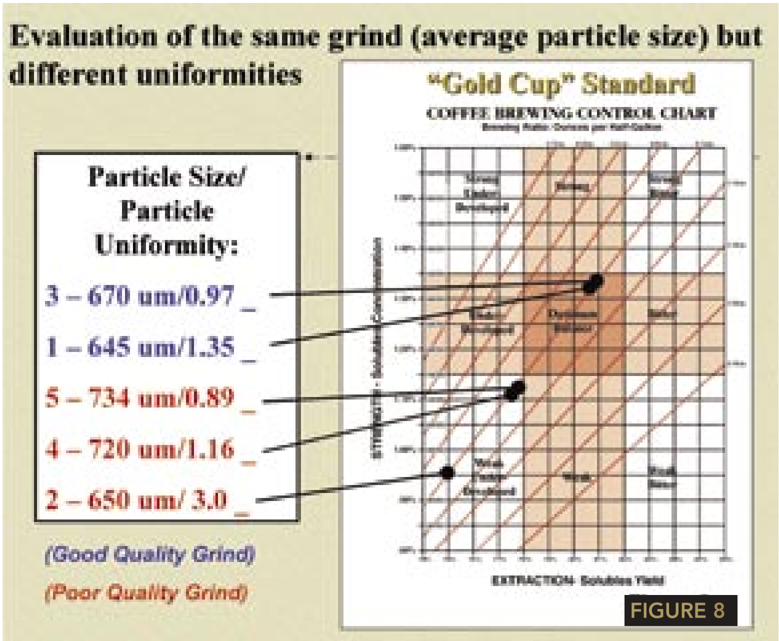

FIGURE 8

DANIEL EPHRAIM has been active in the development and design of coffee grinding equipment for the past 20 years. He has presented at numerous Tea & Coffee Trade Journal *conferences and conducted more than 100 coffee grinding seminars at coffee manufacturing facilities in North America and overseas. His company, Modern Process Equipment, Inc., is based in Chicago.*