Grinding various types of tea

Tee Tea – Herbal Teas, Black Tea or Green Tea

An efficient sample preparation for quick, dependable and reproducible analyses results is nowadays becoming increasingly more important. Especially in the food industry is an exact sample preparation as a prerequisite for fine analyses essential, in order to be able to comply with specified limit and tolerance values.

Fig. 1: Common regular tea

Up until now many users achieved very good, dependable analyses results in the heavy metal analysis of plants with rotor mills. On the one hand the demands and requirements in regards to exactness and reproducibility of the analyses results are rising and on the other hand the critical values for the contents of heavy metals are being further lowered. Today, newer analysis procedures like for example the ICP-MS allow the proof of trace elements up into the ppt-range. These instruments often operate with smaller net weights for the analysis. Therefore inevitably the requirements in regards to quality and homogeneity of the samples rises i.e. the samples have to be ground finer and finer.

Working principle of the Variable Speed Rotor Mill

Rotor mills distinguish themselves with a rotor with high rotational speeds. A sieve defines the fineness of the sample. Plants, especially their stems contain long fibred ligneous parts. The high rotational speed of the rotor causes an aligned air current. In this current though elongated parts are aligned in a manner so they can pass the sieve. An extreme example in regards of these material characteristic is described in the report **Purple Moor-Grass.** These characteristics limit the achievable end fineness.

Milling of green tea

In order to meet the new requirements of sample preparation we followed the request of a customer in grinding tea clearly finer, available tea was comminuted in the **Planetary Micro Mill PULVERISETTE 7 *premium line***.
The grinding set consisted of zirconium oxide grinding bowls with 15 mm diameter grinding balls.
Experience has shown positive results when zirconium oxide was used as the grinding material for the preparation of plant samples and also the chemical contents of zirconium oxide does not alter the analysis results.

Fig. 2: Loose leaf green Tea

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Test with the PULVERISETTE 7 *premium line*

After a brief preparation time with the mill PULVERISETTE 7 premium line the result shown in the photo was achieved. This concurs with the so far made experiences in sample preparation of plant samples with planetary mills.

Fig. 3: Grinding bowl and grinding balls made of zirconium oxide

Comminution of green and black tea

As an additional test we comminuted customers' samples – this time black and green tea – with the Planetary Micro Mill PULVERISETTE 7 *premium line*. Again we used a zirconium oxide grinding bowl 45 ml and 15 mm grinding balls.

Fig. 4: After three minutes the results shown in the photos were achieved. Immediately after opening the grinding bowls the temperature was taken and the values were just below 40 ° C.

With other Planetary Ball Mills from our product line with similar conditions comparable results can be achieved.

Test with the Variable Speed Rotor Mill PULVERISETTE 14 *classic line*

In order to gather the quantifiable difference between these two mill types, the green tea was comminuted parallel to the above test with the Variable Speed Rotor Mill PULVERISETTE 14 *classic line* using a 0.08 mm sieve.

With rotor, respectively centrifugal mills, a sieve defines the final fineness. Hence a reference point for the particle size distribution for samples prepared in this manner exists.

Optically both samples look very similar. At least at first glance a really big difference cannot be seen.

Fig. 5: On the left is the comminuted sample processed with the Variable Speed Rotor Mill PULVERISETTE 14 and on the right the sample comminuted with the Planetary Micro Mill PULVERISETTE *premium line*.

Determining the particle size distribution

The determination of the particle size distribution with the **Laser Particle Sizer ANALYSETTE 22** plus clearly shows a different picture.

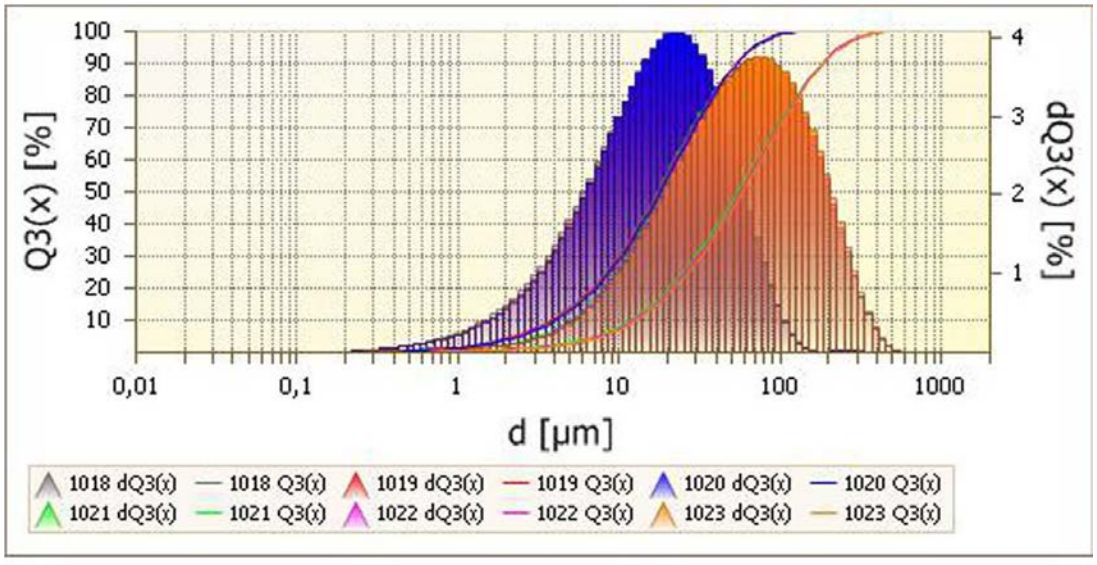

Fig. 6: Blue Curve comminution with the Planetary Micro Mill with the PULVERISETTE 7 *premium line*
Orange Curve: Comminution with the Variable Speed Rotor Mill with the PULVERISETTE 14 *classic line*

All samples were measured in water. Both distributions are secured with three measurements in chronological order. There are no drifts of the measuring values over time. Tea can therefore be measured with those dispersion conditions.

Blue Curve

- **Green tea** comminuted 3 minutes with the **Planetary Micro Mill PULVERISETTE 7 premium line** using zirconium oxide grinding bowls and grinding balls with 15 mm diameter
  d10 = 3.9µm d50 = 17.8 µm d90 = 53.8 µm

Orange Curve

- Green tea comminuted with the **Variable-Speed Rotor Mill PULVERISETTE 14 *classic line*** using a 0.08 mm sieve
  d10 = 12.2 µm d50 = 56.5 µm d90 = 184.4 µm

Despite using a 0.08 mm sieve in the Variable Speed Rotor Mill, are only 63 % < 80 µm, only 86 % < 160 µm – double the mesh width of the sieves - and 99.6 % < 400 µm – fivefold the mesh width of the sieves.

The reason for this is very simple!
A sieving is a two dimensional observation of the particle size. Oblong particles are aligned by the air current pass the sieve. But we always associate with a particle size a sphere – this is wrong.
The Laser Particle Sizer considers by avoiding laminar flows in the measuring cell and a statically secured amount of measuring values, all three dimensions. Detailed information about these topics is contained in the report Purple Moor Grass.

In conclusion: With planetary mills plant samples like different kinds of tea can clearly be ground finer than with a Variable Speed Rotor Mill.

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