

Influence of Cryo-Grinding on Particle Size Distribution of Proso Millet Bran Fraction

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The aim

- The aim of this study was to determine the particle size distributions of the proso millet (*Panicum miliaceum*) bran fraction grinded at cryogenic temperature (using liquid nitrogen (LN₂) cooling, T = - 196 °C), in comparison to non-cooled grinding



Experiment set-up

Milling (CryoMill, Retsch GmbH, Haan, Germany)

Without cooling

- 2, 4, 8 and 12 minutes

With LN₂ cooling

- 2, 4, 8 and 12 minutes

At cryo-temperature with
included 1 minute of intermediate
cryo-cooling step after every 2
minutes of grinding

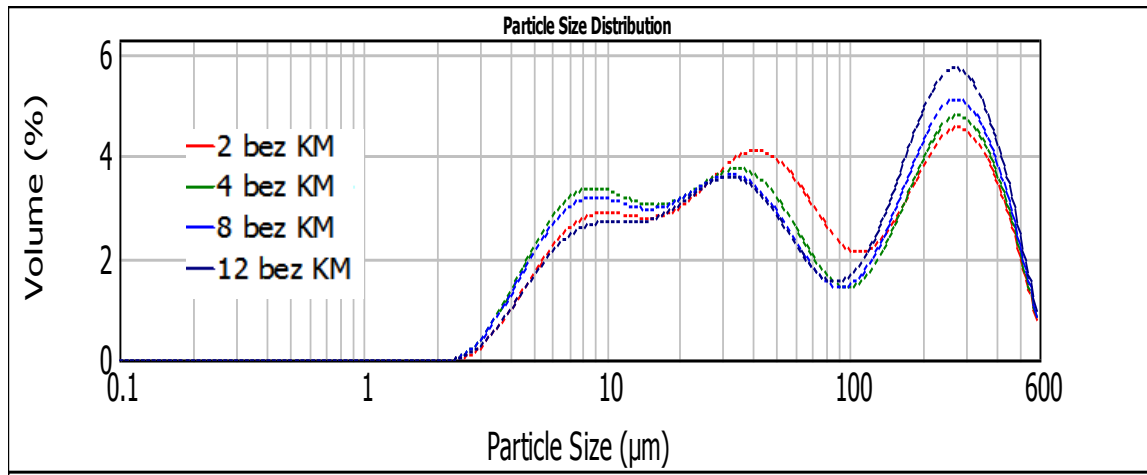
- 4, 8 and 12 minutes

Laser diffraction particle sizing (Mastersizer 2000, Malvern Instruments, UK)

Dry dispersion: Scirocco 2000

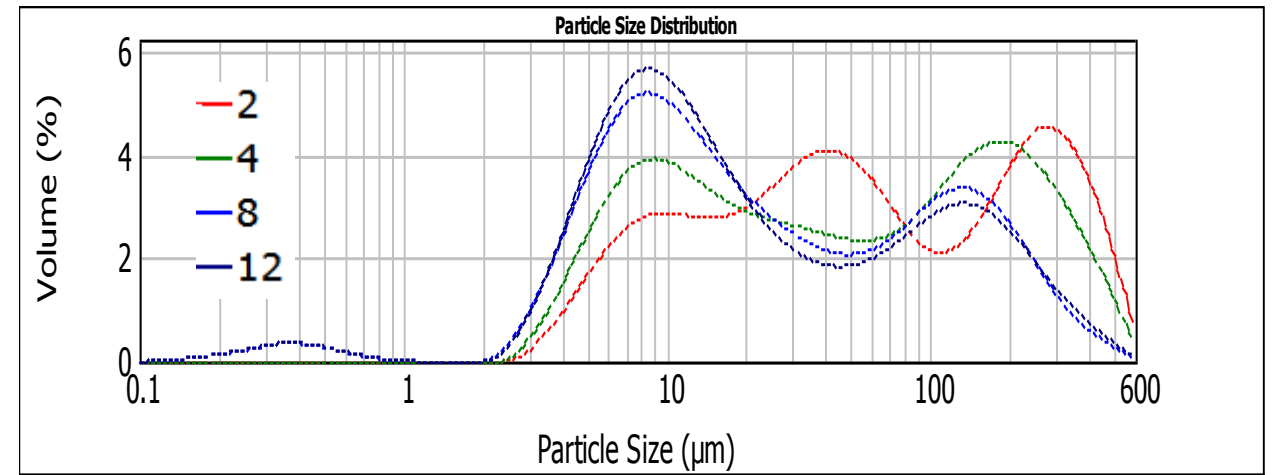
Results & conclusions (1)

Without cooling



Sample	d (0.5) [μm]	Span	SSA
2	51.29±1.28	6.42±0.10	0.26±0.01
4	43.00±1.33	7.81±0.22	0.30±0.01
8	46.97±1.05	7.29±0.16	0.29±0.01
12	62.85±2.20	5.61±0.17	0.25±0.01

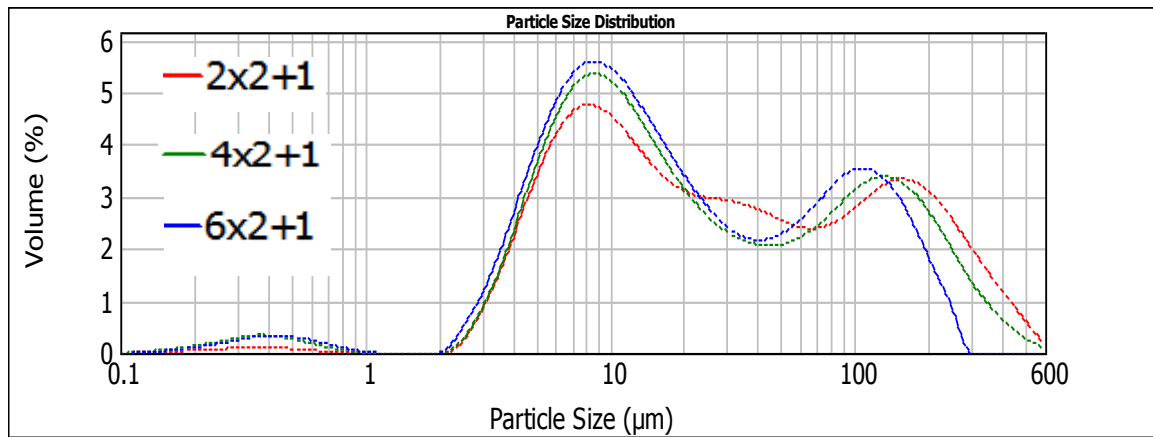
With LN₂ cooling



Sample	d (0.5) [μm]	Span	SSA
2	54.28±6.57	6.42±0.57	0.30±0.01
4	44.44±4.74	6.21±0.56	0.30±0.01
8	18.57±0.18	9.35±0.06	0.94±0.00
12	16.34±2.09	10.47±0.12	0.90±0.06

Results & conclusions (2)

Results (with intermediate LN₂ cooling)



Conclusions

- grinding time at all three modes had a significant effect on all particle size parameters: $d(0.1)$, $d(0.5)$, $d(0.9)$, $D[3,2]$, $D[4,3]$, span and specific surface area. Longer grinding times resulted in lower values of the above listed parameters
- samples with LN₂ cooling exhibited lower diameters in comparison to non-cooled
- intermediate cooling is not necessary for the proso millet grinding

Sample	$d(0.5)$ [µm]	Span	SSA
4	38.70±1.22	8.44±0.33	0.34±0.00
8	19.40±0.12	9.54±0.27	0.91±0.10
12	15.83±0.36	7.90±0.23	0.92±0.03