PHYSICAL PROPERTIES OF DIFFERENT NUT BUTTERS

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Objective

In recent years, as consumer demand for healthy diets increased, tree nuts become more popular. The term plant-based butter made from nut or seed refers to a product with at least 90% nut/seed, while the term spread refers to a product with at least 40% nut/seed ingredient which can be added in various forms, e.g. as nuts, a paste and/or a slurry. Both spreadable products are made from nuts that are ground into a paste. The process of grinding affected the quality of the nut butter as it determines its particle size, consistency, and viscosity which also influences its physical, textural, and organoleptic features.

The objective of our work was to determine the viscosity, color, and particle sizes of different types of nut butter.

Samples

PISTACHIO WALNUT PEANUT TAHINI

Materials and Methods

Materials: four commercially available nut butters: pistachio, walnut, peanut and tahini

Viscosity measurements:

- The flow curve measurement with Anton Paar MCR302 modular compact rheometer.
- Plate-plate geometry (PP50), temperature: 25±0.2 °C, three replicates / sample type.
- Two measuring stages:
  - increasing the shear rate from 0.0 1/s to 20 1/s; 60 recorded data / curve.
  - second stage: 20 1/s constant shear rate, 60 s, 60 recorded data / curve.
- Determined parameters:
  - apparent viscosity at 10 1/s on the flow curve and
  - dynamic viscosity at a 20 1/s shear rate in the constant stage.

Optical properties:

The CIELAB L*, a* and b* color coordinates were determined with ColorLite sph850 spectrophotometer (ColorLite, Germany). The surface color of all samples was measured with three replicates.

Particle sizes and shapes:

- High-speed image analysis instrument QICPIC (Sympatec GmbH, Germany).
- The nomenclature of the measurement results is in accordance with ISO 9276. The following measuring ranges were selected for the analysis (**Table 1**).

Measuring range	Physical limits / µm	ISO limits / µm
M5	1,8-3755	1,8-1252
M7	4,2-8665	4,2-2888

Settings of the measurements (**Table 2**):

Parameters	Pistachio	Walnut	Peanut	Tahini
amount of sample	0.50 g	0.50 g	0.50 g	0.50 g
measuring range	M5	M5	M7	M7
dispersing liquid	rape oil	rape oil	rape oil	rape oil
stirrer speed	200 rpm	200 rpm	200 rpm	200 rpm
pump speed	100 rpm	100 rpm	100 rpm	100 rpm
measuring time	120 s	120 s	120 s	120 s
pieces of measured particle	20 pcs < 30 µm 16 pcs > 30 µm	20 pcs < 30 µm 16 pcs > 30 µm	20 pcs < 60 µm 16 pcs > 60 µm	20 pcs < 60 µm 16 pcs > 60 µm

Evaluation and determined parameters:

- EQPC (diameter of the circle of equal area),
- FERET_MAX (maximum diameter over all measuring direction),
- FERET_MIN (minimum diameter over all measuring direction)
- Aspect ratio (far) (FERET_MIN / FERET_MAX) and
- Sphericity (fsph) (perimeter of the equivalent circle PEQPC / the real perimeter Preal)
- Cumulative distribution for volume (Qvolume)

Statistics: one-way ANOVA ($p < 0.05$); Tukey HSD post-hoc test (IBM SPSS 27 software).

Conclusion

The apparent viscosity and the average dynamic viscosity values of the four nut pastes were significantly different from each other. Significant differences were found between the different nut butters in the case of the CIE L*, a*, and b* measurement parameters. The viscosity and color results were confirmed by ANOVA as well.

The EQPC results show that the behavior of the tahini is different from the others, it has more particles with bigger sizes. The tahini aspect ratio value was lower than the others, and it showed the biggest particle size based on the measured sample amount. The particle size of the peanut and tahini was bigger, and the tahini particles were less rounded than the other nut butter particle. Based on the results the sphericity decreases with the particle size increasing.

Results

Flow curve – apparent viscosity, dynamic viscosity

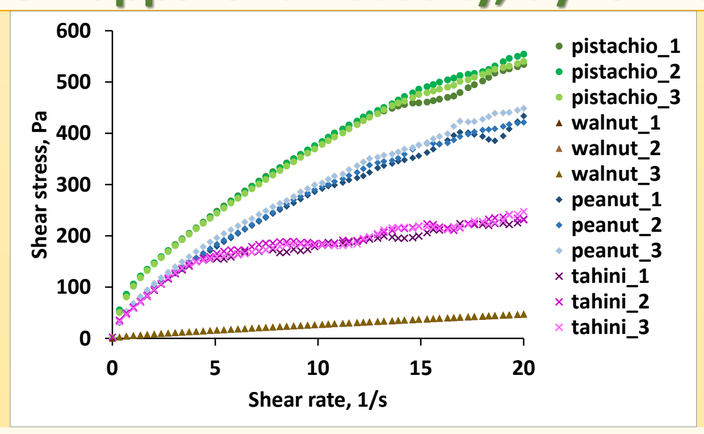

Figure 1 Flow curves of the measured nut butters

Table 3 The average ± standard deviation values of apparent viscosity, dynamic viscosity and decrease of dynamic viscosity

	Apparent viscosity at 10 1/s shear rate (mPas)	Average dynamic viscosity at 20 1/s shear rate (mPas)	Decrease of the dynamic viscosity at 20 1/s shear rate (mPas)
Pistachio	37777 ± 339.4	24763 ± 612.0	4364.7 ± 370.3
Walnut	2704 ± 30.27	2365.5 ± 27.85	18.13 ± 1.193
Peanut	29452 ± 629.6	17757 ± 466.0	6720 ± 81.5
Tahini	18266 ± 248.6	9956 ± 289.5	3720.6 ± 961.8

Color – CIE L*a*b*

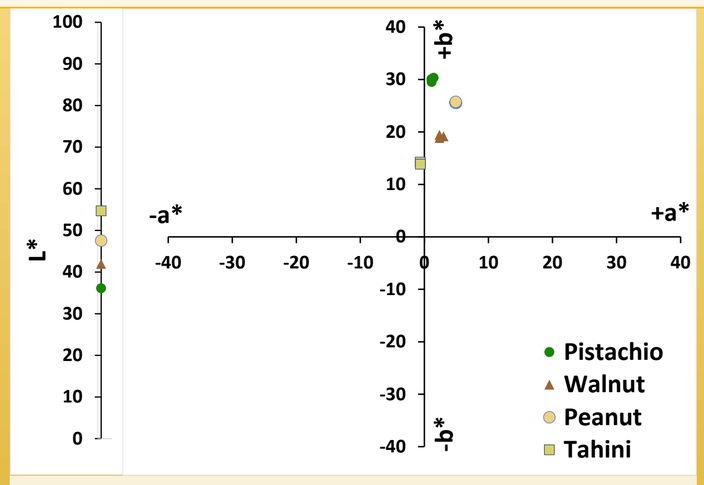

Figure 2 CIE Lab results of the nut butters

Table 4 The average ± standard deviation values of CIE Lab color parameters

	L*	a*	b*
Pistachio	36.72 ± 0.6101	1.220 ± 0.1819	29.98 ± 0.4038
Walnut	41.38 ± 0.7158	2.567 ± 0.3667	19.16 ± 0.2902
Peanut	47.54 ± 0.06658	4.880 ± 0.05568	25.63 ± 0.1210
Tahini	54.49 ± 0.2914	-0.633 ± 0.01528	14.09 ± 0.2066

Particle sizes and shapes

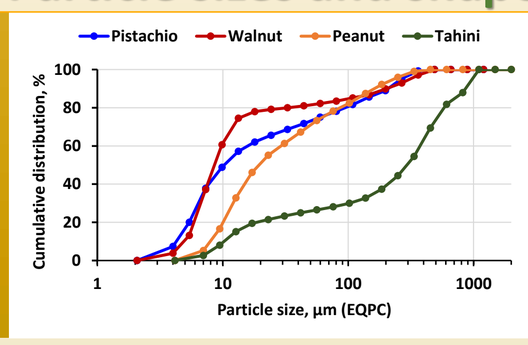

Figure 3 Cumulative particle size distribution curves in % (EQPC)

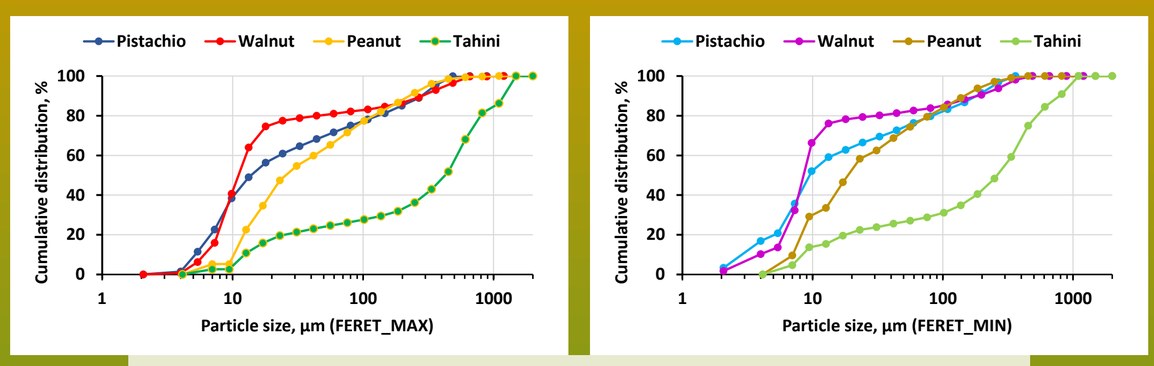

Figure 4 Cumulative particle size distribution curves in % (FERET_MAX (left) and FERET_MIN (right))

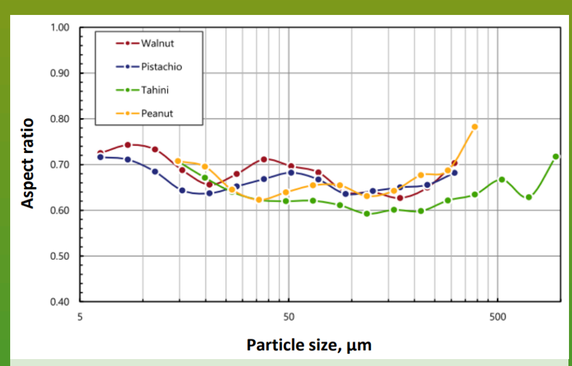

Figure 5 The aspect ratio over particle size (EQPC)

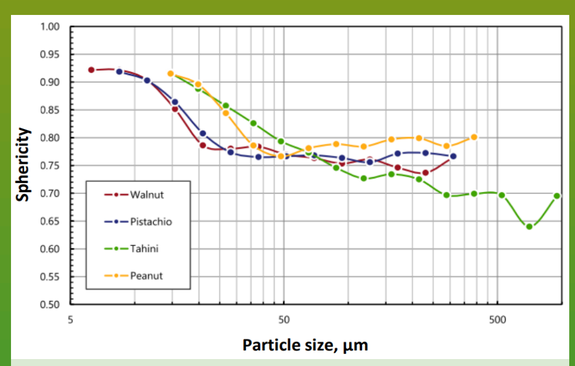

Figure 6 The sphericity over particle size (EQPC)