UNIVERSITY OF HOHENHEIM

Tropentag 2019
Sept 18-20
Universität Kassel & Göttingen

INSTITUTE OF AGRICULTURAL ENGINEERING
Tropics and Subtropics Group

Optimization of drying conditions for cassava foam powder production and properties of cassava foam powder

Oluwatoyin Ayetigbo; Sajid Latif; Adebayo Abass; Joachim Müller

Focus

- Freshly harvested cassava has high water activity, and thus, subject to rapid post-harvest physiological deterioration. It also has relatively high cyanogenic potential.
- Foam mat drying (FMD) of cassava could present a simple means of overcoming these challenges. Therefore, optimizing the drying conditions is essential.
- Processing cassava into cassava foam powder (CFP) could also improve shelf-stability, functionality, nutrient retention, and handling.

Materials & Method

- A white-flesh and a yellow-flesh (IITA-MS-IBA 011368) cassava variety was processed into cassava foam under optimal conditions in a previous study.
- Optimal foams were dried at different temperatures (50, 65, 80 °C) and foam thickness (6, 8, 10 mm) as independent variables. The responses were first and second falling rate diffusivity and time required to dry to 10 % moisture content.
- Drying kinetics, total carotenoids content, total cyanogenic potential, color ratio, microstructure and functional properties of optimally dried cassava foam powders were determined and compared with non-foamed pulp powders.

Results & Discussion

Table 1 Optimal drying conditions and responses for drying of cassava foam into foam powder

	Temperature (° C)	Foam thickness (mm)	1st falling rate diffusivity (x 10^{-9} m²/s)	2nd falling rate diffusivity (x 10^{-8} m²/s)	Drying time to 10 % MC wb (h)
White					
Predicted	80.0	10.0	2.5	1.8	9.3
Validated			2.9	2.2	8.7
Actual			2.6	1.9	9.2
Yellow					
Predicted	80.0	7.87	2.7	1.2	5.3
Validated			2.2	0.8	6.3
Actual			2.6	1.5	5.9

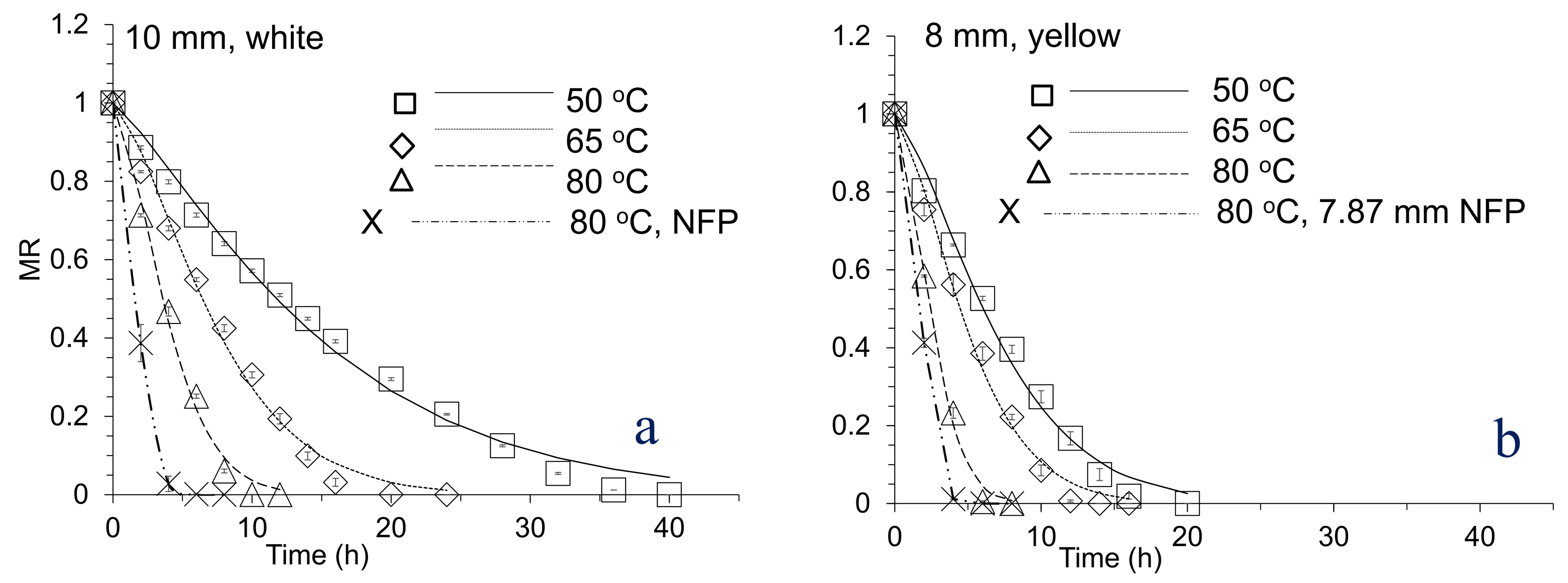

Fig 1 Drying kinetics of (a). white cassava foam (b). yellow cassava foam at different temperatures and optimum drying conditions. NFP: non-foamed pulp

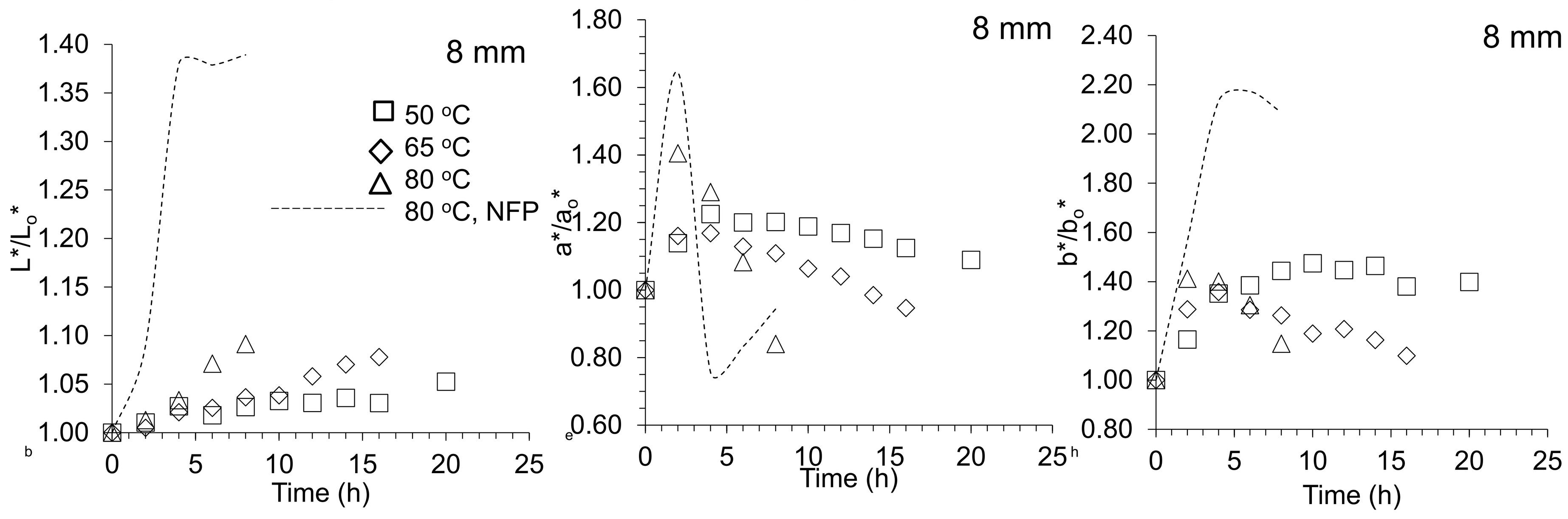

Fig 2 Color kinetics of yellow cassava foam during drying at different temperatures and optimum drying conditions. NFP- non-foamed pulp

Table 2 Physicochemical and functional properties of white cassava foam powder and yellow cassava foam powder dried at optimum drying conditions

	Foam powder	Pulp powder	Foam powder	Pulp powder
	White		***Yellow***	
TCC	-	-	10.39 ± 1.5	14.29 ± 1.4
TCG	29.09 ± 0.03	67.87 ± 6.03	1.58 ± 0.42	264.89 ± 5.10
AA	13.59 ± 6.15	31.06 ± 0.74	17.14 ± 2.77	23.50 ± 0.17
SP	3.99 ± 0.19	8.92 ± 0.02	5.18 ± 0.03	10.65 ± 0.09
SOL	0.104 ± 0.01	0.071 ± 0.001	0.143 ± 0.003	0.0905 ± 0.001
WAC	2.37 ± 0.04	1.70 ± 0.01	3.53 ± 0.02	2.59 ± 0.001
OAC	1.36 ± 0.08	0.84 ± 0.03	1.03 ± 0.02	1.13 ± 0.02
LGC	6	2	6	2

TCC-total carotenoids (μg/g), TCG- total cyanogenic glucosides (μg/g HCN eq.), AA- apparent amylose content (%), SP- swelling power (g/g), SOL- Solubility (g/g), WAC- water absorption capacity (g/g), OAC- oil absorption capacity (g/g), LGC- least concentration for gelation (% w/v)

- The optimization of drying conditions of the foams by response surface method was successful as response models were significant ($P \le 0.05$). Drying temperature influenced color by increasing lightness (L*) and decreasing yellowness (b*) and drying time. Higher foam thickness increased drying time.
- FMD retained 73 % of original TCC in yellow NFP, reduced the TCG significantly to acceptable level, and improved SOL, WAC, and OAC significantly.
- Scanning electron microscopy revealed association between the hydrocolloid foaming agent and starch granules in the foam powder, while non-foamed pulp powder revealed only smooth starch granules.

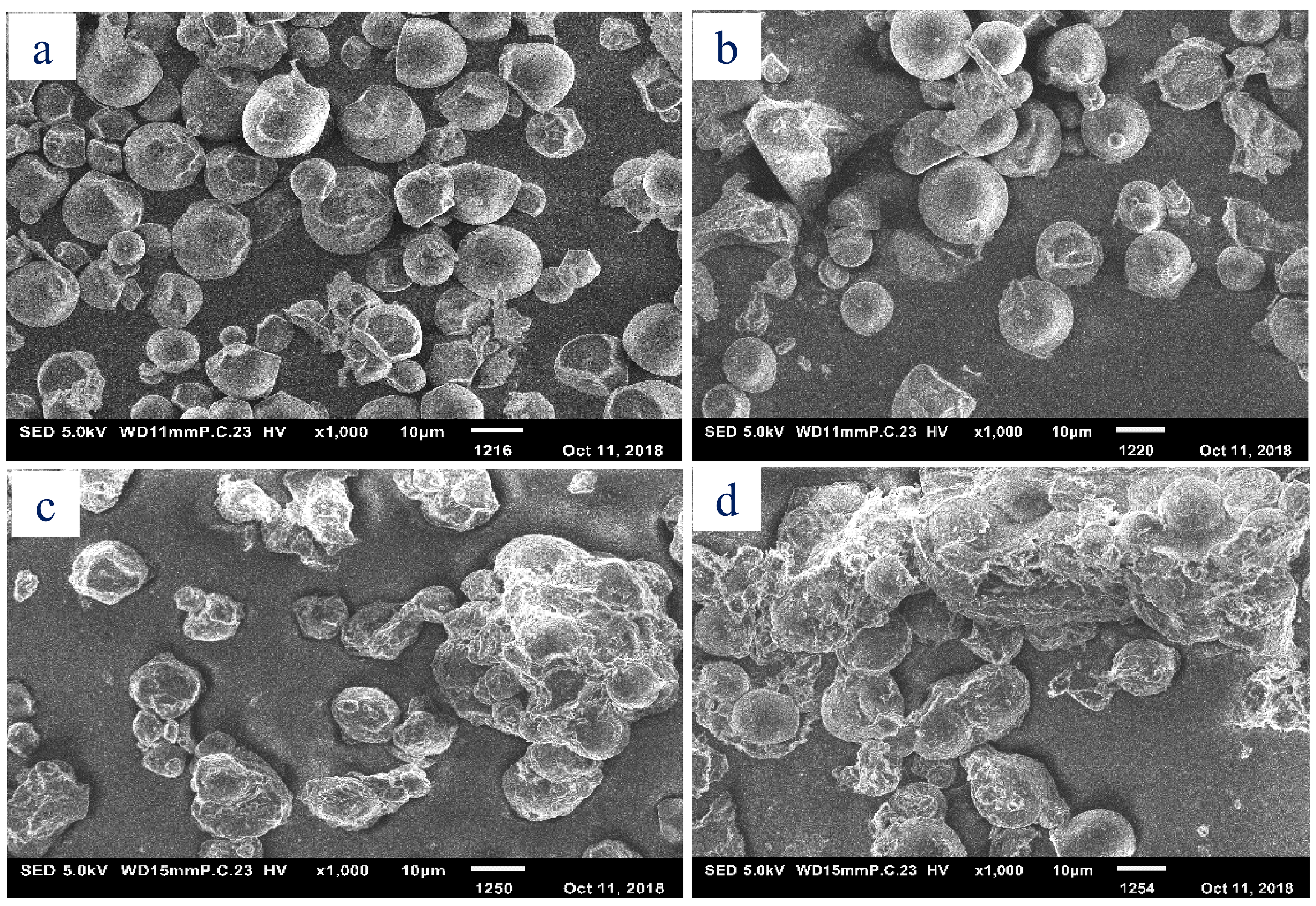

Fig 3 Microstructure of (a). 80 °C, 10 mm white cassava pulp powder (b). 80 °C, 7.87 mm yellow cassava pulp powder (c). 80 °C, 10 mm white cassava foam powder (d). 80 °C, 7.87 mm yellow cassava foam powder

Conclusion

- Foam mat drying of the two cassava varieties was optimized for drying conditions of temperature and foam thickness.
- Varying the drying conditions strongly influenced physicochemical and functional properties of CFP, which was largely retained or improved by FMD.
- Foam powder structure was influenced by the foaming and drying conditions.

Bundesministerium für Bildung und Forschung
zef Center for Development Research University of Bonn
BiomassWeb
IITA Research to Nourish Africa

Contact:
Ayetigbo Oluwatoyin
ayetigbo_oluwatoyin@uni-hohenheim.de
Phone: +49 711 459-24708