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NUTRITIONAL AND FUNCTIONAL CHARACTERIZATION OF PSEUDOCEREALS QUINOA, AMARANTH AND BUCKWHEAT

Introduction

The food industry is currently interested in the use of pseudocereals for the development of nutritious food products. Based on the world production, quinoa, amaranth and buckwheat are the three major pseudocereals. Their proteins mainly consist of albumins and globulins and have a well-balanced amino acid profile. These pseudocereals show important levels of dietary fiber, minerals and vitamins and their fat fraction is characterized by a high degree of unsaturation. The grain characteristics and technological properties of quinoa, amaranth and buckwheat are still insufficiently explored which limits their current utilization in the food industry.

Objective: A sample set of commercially available quinoa (n=7), amaranth (n=8) and buckwheat (n=11) kernels were investigated for the nutritional composition and functional properties of their wholemeal flour in order to expand the knowledge about pseudocereals.

Material and methods

Screening of the nutritional composition included the determination of moisture content (ICC 110/1), ash content (ICC 104/1), protein content (Dumas N × 6.25; ISO 16634-1), crude fat content (ISO 6492) and starch content (Englyst, 1992). Following functional properties were studied: water absorption capacity (Leach, McCowen, & Schoch, 1959; with modifications), starch damage (K-SDAM, Megazyme u.c.) and pasting profile (AACCI 76-21.01, Rheometer Anton Paar).

Nutritional composition

Protein content of quinoa strongly differs among samples (range: 9.5-16.7 %/dm) but is on average the lowest. Lipid levels are significantly lower in buckwheat, about 1.8 times compared to quinoa and amaranth. Protein and lipid levels are highest for amaranth but result in a low starch content; starch content of quinoa and buckwheat are comparable. For amaranth, ash content is higher compared to buckwheat. Ash content for quinoa samples ranges between 1.92 and 3.46 %/dm.

Table 1 Nutritional composition of pseudocereals quinoa, amaranth and buckwheat

	protein (%/dm)	fat (%/dm)	starch (%/dm)	ash (%/dm)
quinoa	13.1 ± 2.2^{b}	6.36 ± 1.65^{a}	67.9 ± 7.4^{a}	2.62 ± 0.59^{ab}
amaranth	15.8 ± 0.5^{a}	6.81 ± 0.29^{a}	61.1 ± 3.2^{b}	2.53 ± 0.20^{a}
buckwheat	15.3 ± 0.7^{b}	3.68 ± 0.12^{b}	71.4 ± 3.6^{a}	2.11 ± 0.12^{b}

Values within the same column marked with the same superscript are not significantly different.

Starch damage and water absorption capacity

Milling of the buckwheat kernels led to little damage of the starch granules while the percentage of starch damage was considerably higher for quinoa and amaranth. This suggests that buckwheat is easier to reduce to flour-sized particles (Barak, 2014). Despite the highest percentage of starch damage, quinoa has a water absorption comparable to buckwheat and rather lower than amaranth.

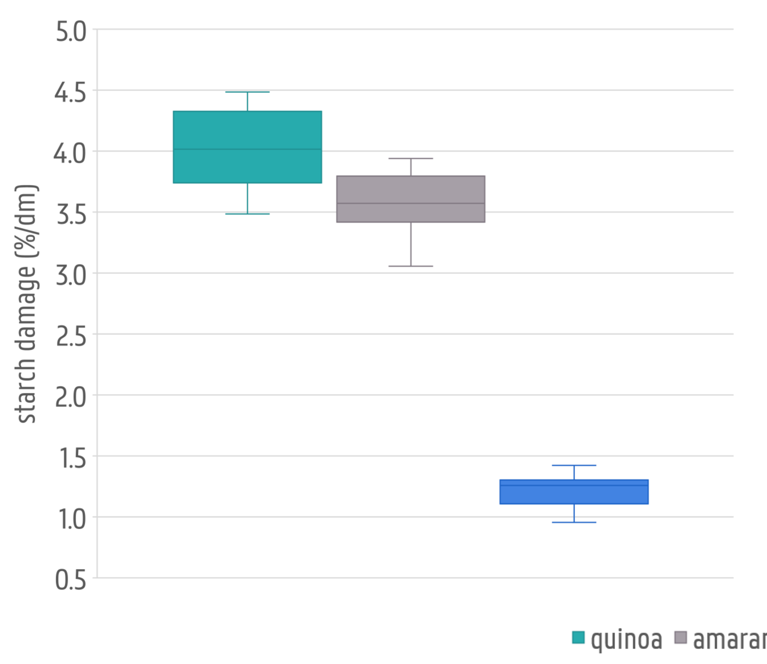

Fig. 1 Starch damage (%) of quinoa, amaranth and buckwheat wholemeal flour

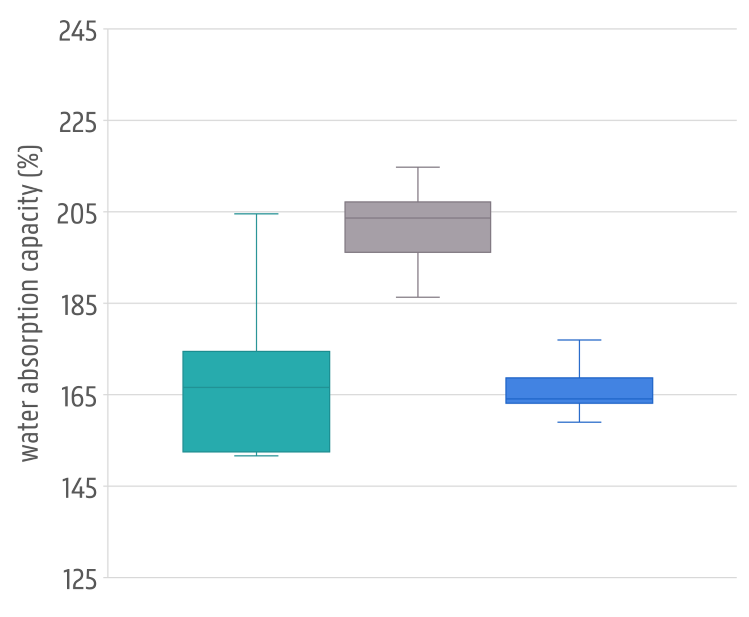

Fig. 2 Water absorption capacity (%) of quinoa, amaranth and buckwheat wholemeal flour

Pasting properties

The pasting profile of quinoa differs considerably among the samples with substantial differences in peak and final viscosities. A second peak in viscosity was observed during the cooling phase for several samples, indicating a disruption of the formed gel structure.

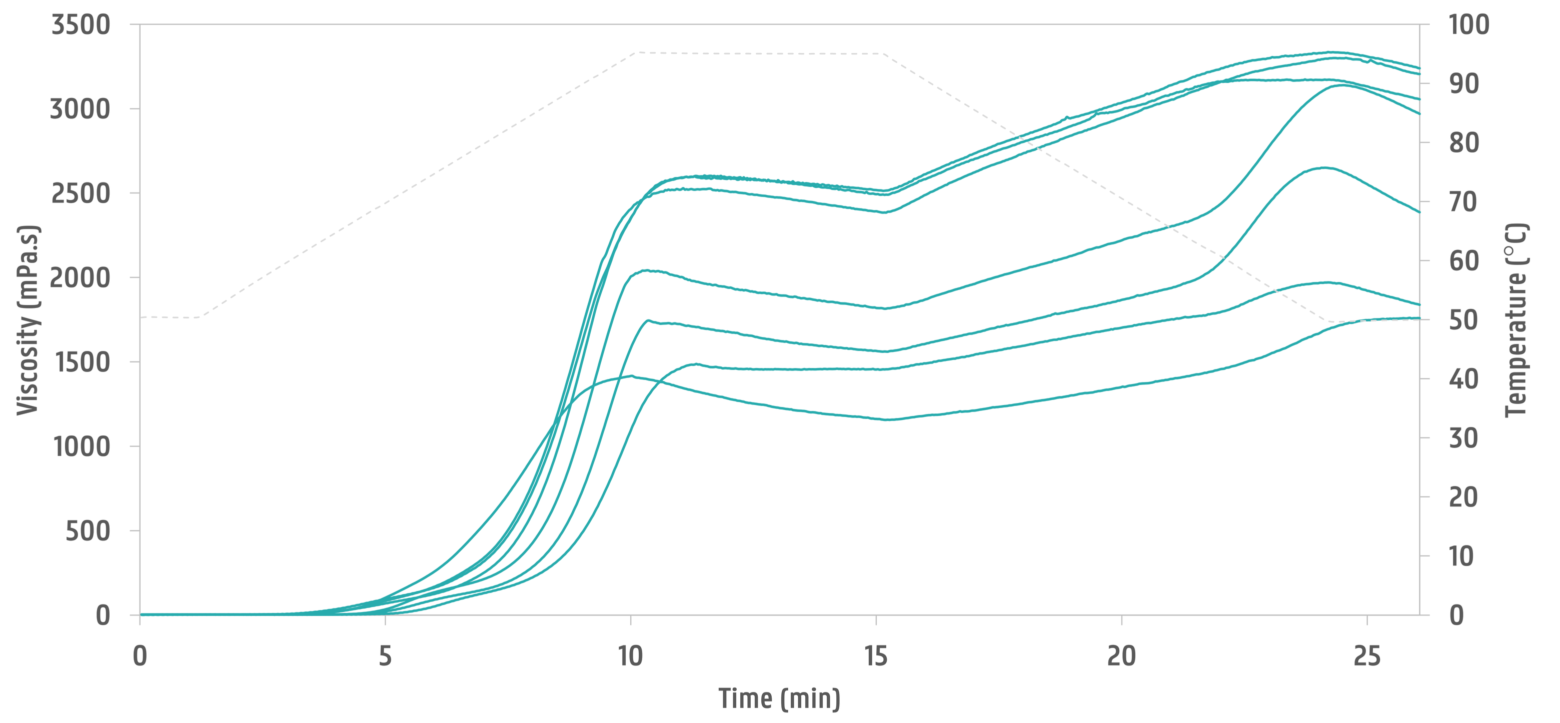

Fig. 3 Pasting profile of seven quinoa samples

Amaranth has an average peak temperature of 84.25 ± 0.88 °C, which is approximately 10 °C lower compared to the other pseudocereals. Viscosity increase is limited during the cooling phase, resulting in negative values for the setback from peak.

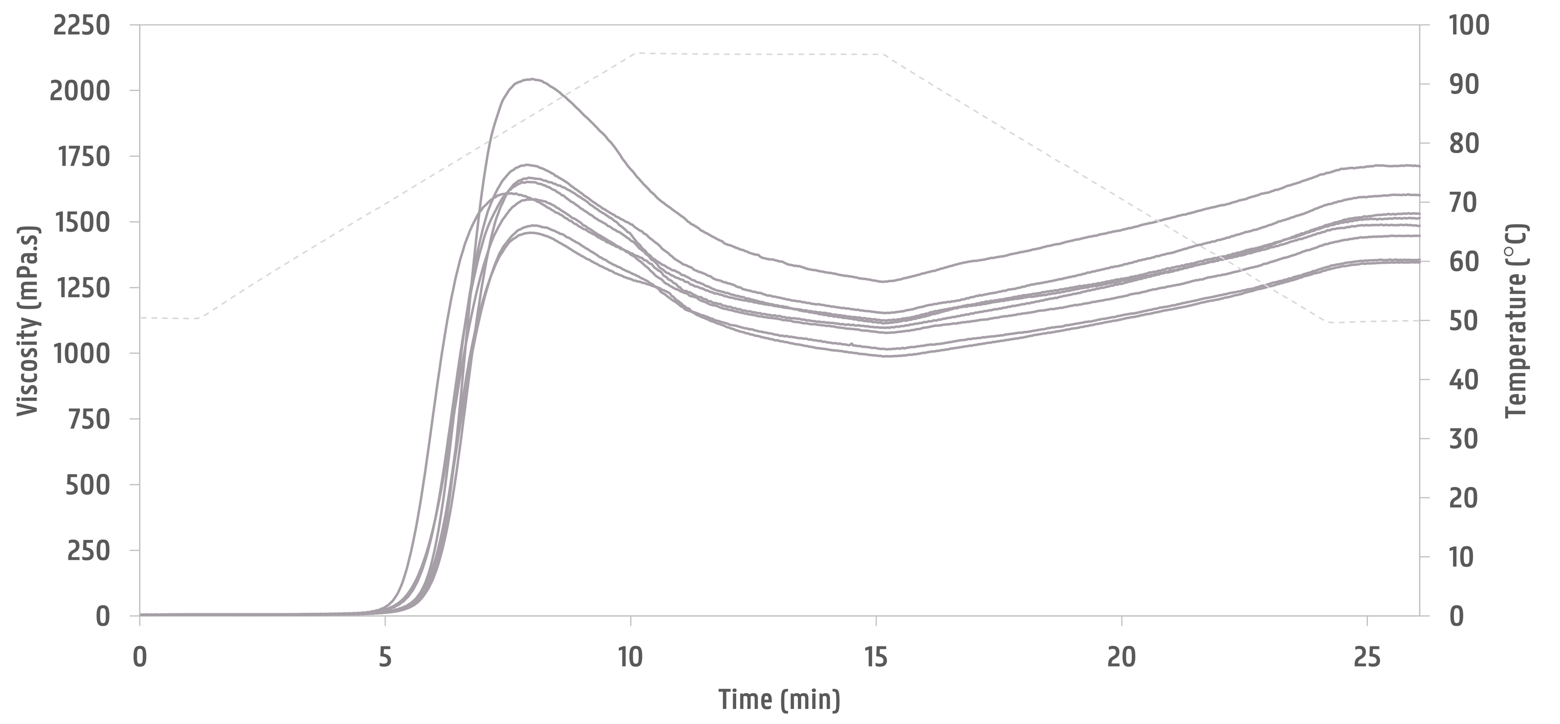

Fig. 4 Pasting profile of eight amaranth samples

Peak viscosity is considerably higher for buckwheat. Its pasting profile is characterized by a strong viscosity increase once the cooling phase is initiated. The resulting final viscosities range between 5535 and 7661 mPa.s.

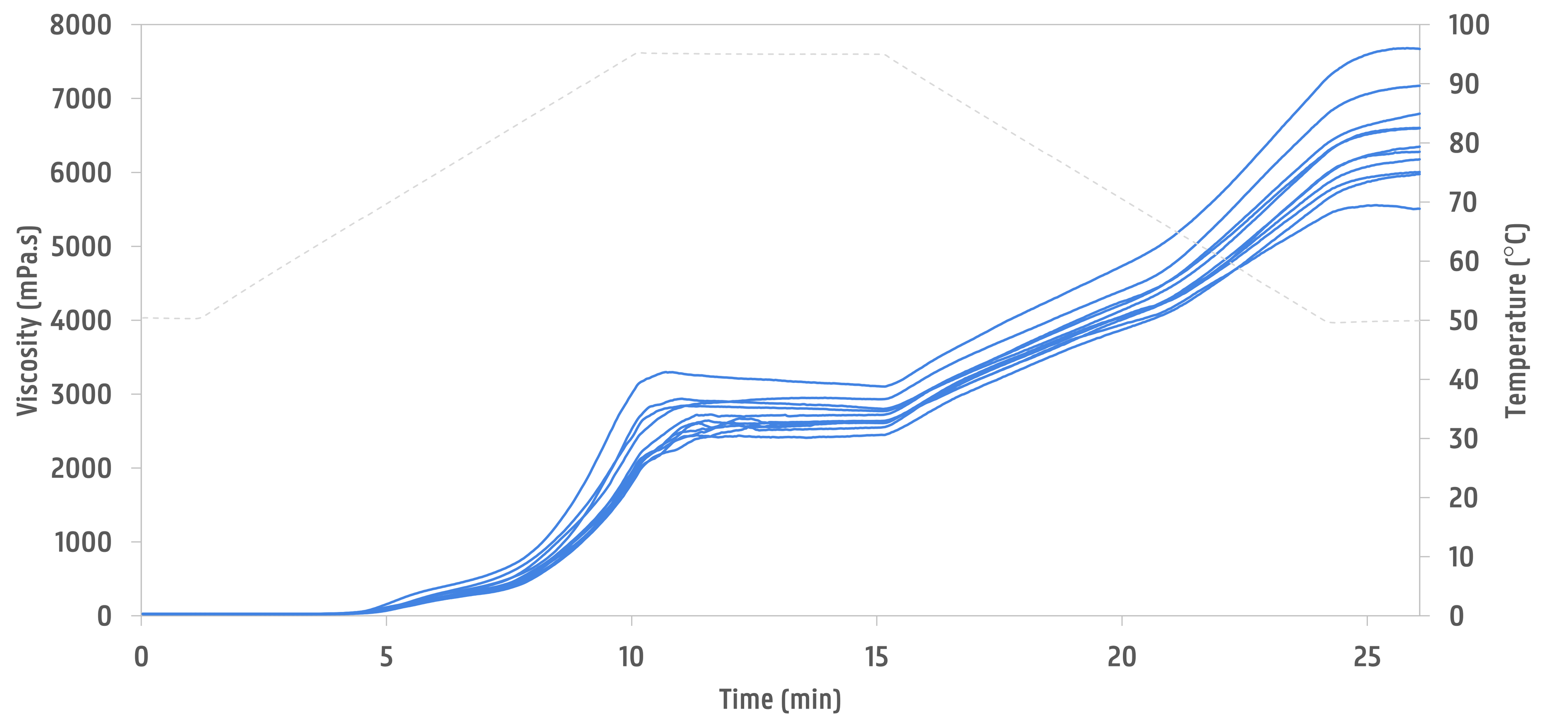

Fig. 5 Pasting profile of eleven buckwheat samples

Conclusion

Amaranth is characterized by the highest amount of fat and proteins. Fat content is considerably lower for buckwheat but this pseudocereal contains more starch. Ash content is higher for quinoa. The nutritional composition of quinoa showed more variability within samples.

Despite the difference in starch damage, water absorption is comparable for quinoa and buckwheat. The pasting profile of quinoa depends upon the studied samples. Amaranth has a lower peak temperature and formation of a strong gel is limited during the cooling phase. However, buckwheat's pasting profile is characterized by a high final viscosity and setback from peak.

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