Description of rolling as unit operation during the couscous process

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- Optimisation of couscous processing
- New physical approach on rotating drum
- Increase in efficiency of rolling process

Couscous agglomerates are made from durum wheat semolina by the succession of 4 unit operations: agglomeration, rolling, cooking and drying. Rolling stage is conducted to give a spherical shape to the agglomerates and to separate them according to size criteria. Continuous rolling drum is used by industry, and for some of them it is composed of an inclined perforated cylinder rotating about its central axis. The rolling stage is one critical operation during the couscous grain processing, as rolling mainly determines the process yield, by generating significant mass flows of too small and too large agglomerates that could reach more than 60% of the total mass flow. The objective of the present work is to investigate the rolling stage as a unit operation, to determine the rolling process efficiency and its contribution on the structuring mechanisms of the couscous agglomerates.

We used specific rolling equipment at pilot scale. Two metal grids allow separating the agglomerates in three fractions: fine, medium, and large agglomerates. Durum wheat semolina was used as raw materials to generate the wet agglomerates by a standard procedure. We investigated (i) the screening efficiency by assessing the three fractions yield, (ii) the rolling efficiency by measuring the circularity of agglomerates after rolling; (iii) the secondary agglomeration mechanisms by comparing the size distributions of the agglomerates before and after rolling; and (iv) the impact of rolling conditions on the hydro-textural characteristics of agglomerates.

Results demonstrated that the rolling operation induces slight changes in the structure of the agglomerates and generates secondary agglomeration mechanisms. The change in setting conditions of the rolling operation has no significant impact on the screening efficiency and on the hydro-textural characteristics of agglomerates (diameter, compactness, and water content). A physical approach was conducted to determine both the sieving and passing speeds of agglomerates and showed that classification function of the rotating drum can be greatly improved.

Bettina Bellocq is in her second year of PhD in process engineering and food science. Her PhD subject purposes a multi scale approach to control and redesign the transformation of durum wheat semolina in couscous grains. The context of this thesis is based on the connection between physics of granular media and food science. Bettina is a member of Agreenium's International Research School. She is currently supporting a knowledge transfer partnership with the University of Cambridge.