Rheology and Functionality of Cheese Powders

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ABSTRACT

Three cheese powders of different ripening degrees (3, 11 and 52 weeks) were manufactured and subjected to a three step oscillatory test (stress, time and frequency sweep), which was effective in highlighting the differences between cheese powders. The oscillatory method served also to assess cheese powder functionality in savoury baked cheese snacks. Finally, the effect of adding cheese powders with different ripening degree to the standard cheese powder used in cracker manufacture was investigated.

INTRODUCTION

Cheese powders are used as functional and natural flavour ingredients in a wide range of applications including biscuits, savoury snacks, bakery, sauces, dressings, ready meals and processed cheese.

The inherent variability encountered in the cheeses used as raw materials, e.g. their manufacturing process, ripening degree or storage conditions, makes difficult to obtain cheese powders with a constant functionality and flavour from batch to batch. The importance of controlling functionality is highlighted in applications such as savoury baked cheese snacks, i.e. cheese crackers, where substantial differences in baking and final properties can be observed.

Hence the aim of the present study was to develop a rheological protocol capable of differentiating between cheese powders with different ripening degrees and relating to the cheeses used as raw material. The observed rheological differences should also aid in predicting the functionality of the powders in savoury baked cheese snacks.

RESULTS AND DISCUSSION

Rheological characterization of raw cheeses

Uniaxial compression tests were performed with an Instron 5564 Universal Testing Machine (Instron Ltd, High Wycombe, UK) equipped with lubricated steel plates upon the Danbo cheeses used as raw materials in the cheese powder production. From the results, the extent of proteolysis that the cheeses had undergone was accounted as the main factor influencing the fracture strain (ε_f), stress (σ_f) and Young's modulus (E). However, other factors such as moisture, pH, fat content, etc, might have also been involved.

Rheological characterization of cheese powders

The protocol consisted of a three step oscillatory test (stress, time and frequency sweep) carried out upon three cheese powder dispersions (3w-, 11w- and 52w-CP) with a Haake Rheostress 600 rheometer (Haake Thermoelectron GmbH., Germany). Differences among the cheese powders were shown during the stress sweep, where the youngest cheese powder dispersion resulted

in higher yield stress values than 11w- and 52w-CP. These differences were also reflected during the following time sweep, where the samples were allowed to recover their initial structure. The cheese powders exhibited frequency dependent behaviour with a tendency towards an elastic behaviour.

Fourteen rheological variables were selected and together with protein fractionation results subjected to Principal Component Analysis (PCA). As ripening proceeded, the cheese powders showed more viscous-like behaviour, which is in accordance with a more degraded protein network. Likewise, the rheological results of the cheese powders were in accordance with the uniaxial compression studies carried out on the raw cheeses.

Baking tests

Baking tests were carried out with the three model cheese powders (3w-, 11w- and 52w-CP) plus a standard cheese powder usually employed in cheese cracker manufacture. The biscuits were physically evaluated (length, width, thickness, density) and their resistance to cutting was assessed using a Texture Analyser (TA.XT2i Stable Micro systems, UK).

The selected rheological variables were strongly correlated to the parameters obtained from the physical and textural evaluation of cheese crackers. Moreover, the ripening degree of the cheese powders greatly influenced their functionality in savoury cheese baked snacks. For the cracker recipe used in this study, the addition of mild cheeses seemed to result in a cracker most closely resembling the standard.

Effect of blending cheese powders

5, 25 or 50% of each model cheese powder was blended with the standard powder and their respective dispersions were subjected to the three step oscillatory test. The results showed that not only the ripening degree of the cheese powders, but also their level of addition had an influence on the rheological properties of the cheese powder dispersions. When 3w- and 11w-CP were added at 5 and 25% ratios to the standard powder, the newly formed blends exhibited slightly increased elastic character. Above 25% of addition, the blends exhibited a considerably higher viscous-like behaviour. When the most mature of the cheese powders was added to the standard powder the elasticity in all cases decreased. These results suggested that not only the microstructure of the cheese powder, but also the interaction between particles was important. Moreover, the amount of surface free fat present in the three model cheese powders can be assumed to be high, but differing between powders. This might have led to inter-particle stickiness, hindering water from fully penetrating the powder mass. Consequently, the oldest cheese powder dispersion (52w-CP) might have had the highest amounts of surface free fat, resulting in the most viscous-like behaviour.

CONCLUSION

The developed rheological protocol was effective in characterizing the viscoelastic behaviour of cheese powders. The rheological behaviour exhibited a close relationship with the ripening degree of both the raw cheeses and their respective cheese powders. Furthermore, the rheological parameters obtained in the oscillatory measurements of cheese powders succeeded in predicting their functional behaviour in savoury baked cheese snacks.

Finally, both the ripening degree of the blended cheese powders and their ratio of addition were shown to influence the rheological behaviour of the samples. Other factors such the surface free fat are expected to have influenced these results. Moreover, it was confirmed that a rheological evaluation of cheese powders can be used to select which cheese should be added to a particular recipe.