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# Product model for starch-based acid sauces*

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This note describes the usefulness of the Rapid Visco Analyser (RVA) in the development of a product model for starch-based acid sauces. Starch is the major single energy source in the human diet. It is a cheap and versatile functional ingredient in food and non-food applications. Starch is widely used as thickener in sauces and dressings. Basically, the making of a sauce involves nothing more than heating and cooling the formulation. Commercial sauce-making is usually more complex because of demands regarding pH and shelf life (microbiological and storage stability), and the optional presence of oil in the product. This may require additional heating (at > 100 °C) and emulsification steps (high shear) in acid medium. Starches for such sauces should be heat, shear, acid, and storage stable. This stabilisation is normally achieved by chemical cross-linking and partial etherification/esterification of the starch.

Starch producers offer a whole range of specialty starches for sauce applications. Some of these are tailored to meet specific requirements, e.g. starches that display their thickening action only in the course of the final processing step. Other so-called multi-purpose starches may not be the first choice in a specific application, but are satisfactory over a broad variety of processing conditions. As a result, food manufacturers are faced with the task of selecting the optimal starch from a rather large number of products for their applications. Even on a pilot scale this is a costly and time-consuming procedure.

We have designed a product model for medium viscosity acid sauces to overcome costly and time-consuming experiments. Features of this model are that it is simple, representative and applicable on a small scale. 'Simple' means that the model contains only the ingredients that are relevant to the functionality of starch in real sauces. Our product model contains water, modified starch, xanthan, sugar, salt, acid, and preservative. The content of some of these ingredients in the model was derived from (averaged) label information and/or compositional analysis. The amounts of starch and xanthan were established by comparing RVA profiles of commercial sauces to those of

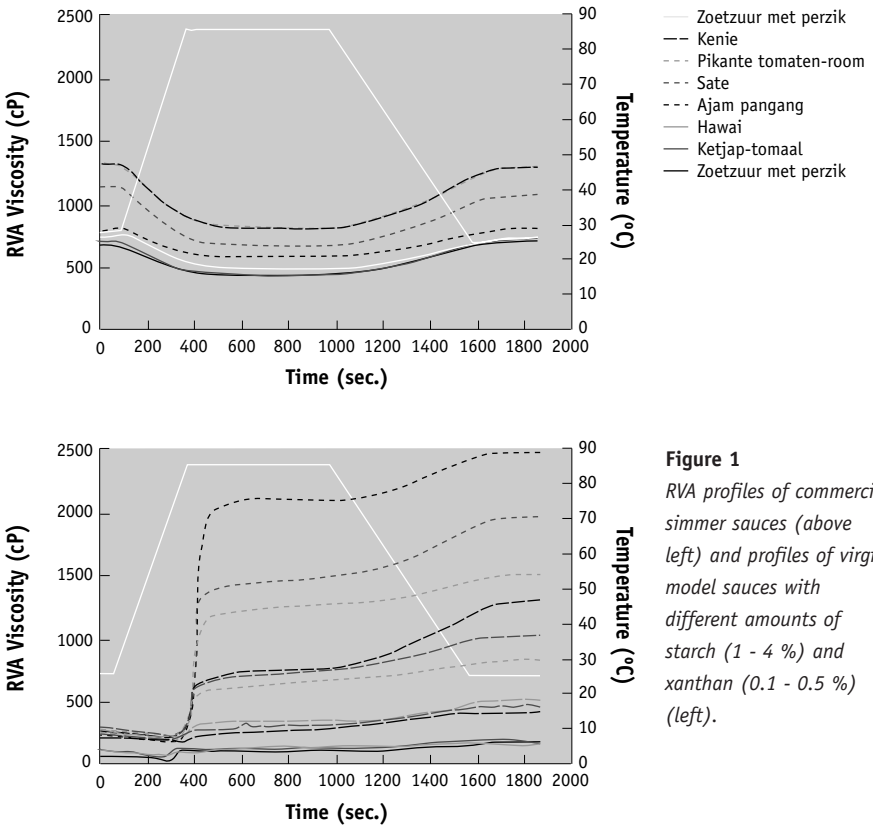


**Figure 1**
*RVA profiles of commercial simmer sauces (above left) and profiles of virgin model sauces with different amounts of starch (1 - 4 %) and xanthan (0.1 - 0.5 %) (left).*



*This work has been performed in the framework of Agrobiokon, a collaboration of TNO, AVEBE, Central Arable Farming Marketing Board (HPA), and Northern Netherlands Assembly (SNN).

model formulations with different amounts of starch and xanthan, when subjected to a program that involves heating from 25–85°C, hold at 85°C, cooling to 25°C and hold at 25°C (Figure 1). Important parameters are the hold and final viscosities at 85°C and 25°C respectively, and the slope of the profile on cooling.

The performance of a starch as a thickener in a model sauce was tested for different processing conditions that involved variations in pH and in temperature and shear treatment. The finished model sauce was evaluated in the RVA by using the temperature program described above. The final RVA viscosity after cooling was used as the key parameter for thickening performance. Figure 2 shows the results for model sauces with three different starches, which were subjected to 14 different variations in processing conditions. These results are plotted as a 'spider web plot'. Multi-purpose starches should exhibit a viscosity that is rather independent of the processing conditions, i.e., as a concentric circle in the plot. Best starch in this respect is starch A1, although its thickening power is not very high. Starch B2 gives substantially thicker sauces, but only when processed at mild conditions. This starch breaks down (i.e., is overcooked) at conditions of high temperature and shear. Starch B1 is in between the two.

We have demonstrated the ability of our product model to assess the functionality of starches as a thickener in sauces subjected to a wide range of processing conditions in a short time and with only small amounts of starch.

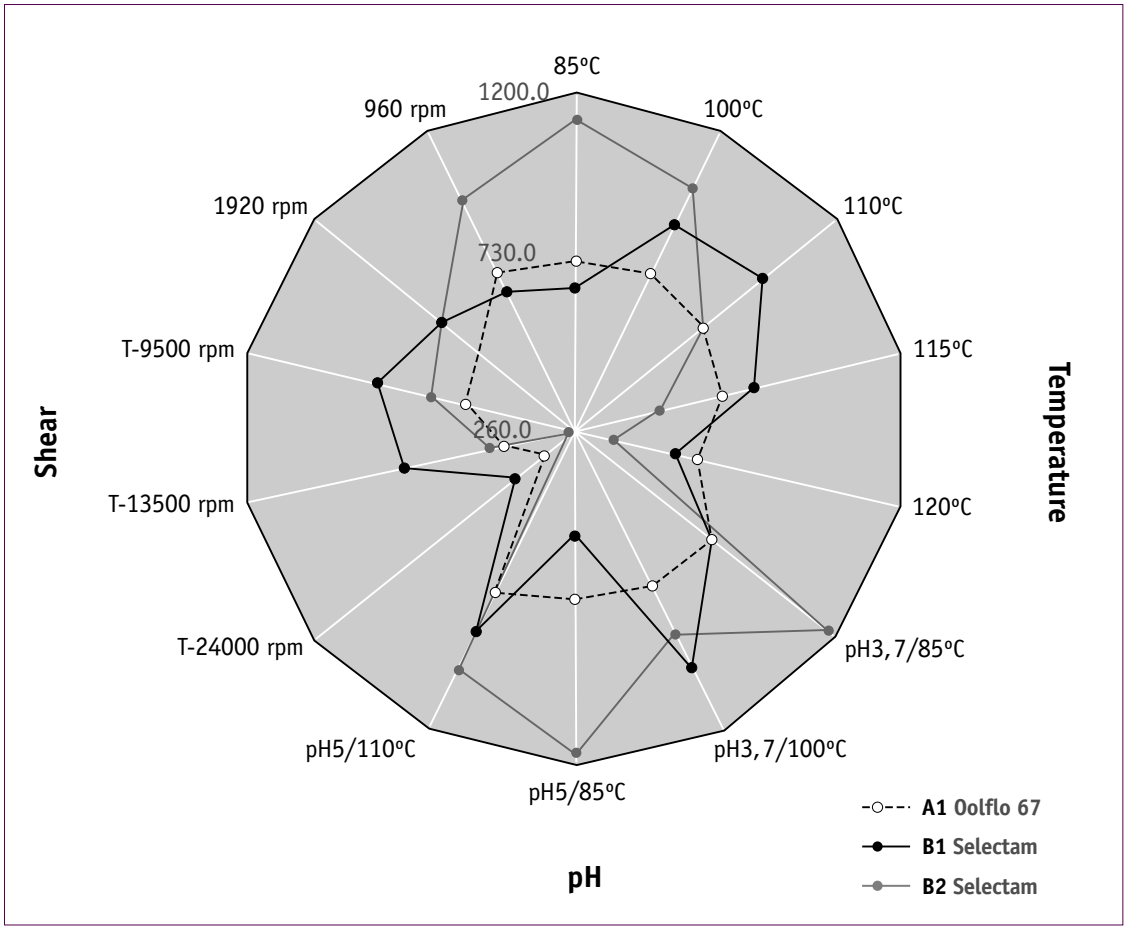


**Figure 2**
*Spider web plots demonstrating thickening ability of starches A1, B1, and B2 in model sauces subjected to 14 different processing conditions. Constant viscosity is represented by a concentric circle in the plot.*

 

# Newly developed methodologies for the determination of the viscous properties of *whole* digesta derived from finisher pigs fed soluble or insoluble NSP-based diets

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## BACKGROUND

Contrasting levels of soluble and insoluble non-starch polysaccharides (NSPs) are commonly used in non-ruminant animal feeds. These NSPs contribute to digesta viscosity to a different extent, and soluble NSPs in particular have possible anti-nutritional properties as a result of their believed contribution to increased digesta viscosity. This belief developed from a large number of studies, which have relied upon digesta supernatant viscosity measurements.

## INTRODUCTION

The usefulness of the internationally accepted standard protocol whereby the viscosity of digesta supernatants is analysed has been recently questioned when solid particles were shown to contribute to the basic viscoelastic properties of digesta to a greater extent than originally thought (Takahashi & Sakata 2002, 2004). To date, few studies have attempted to measure *whole* digesta viscosity and no standardised protocol for such measurements has been recommended.

## OBJECTIVE

The objective of the current study was to develop, test and validate two protocols for the measurement of the viscosity of *whole* digesta sampled from finisher pigs.

## MATERIALS AND METHODS

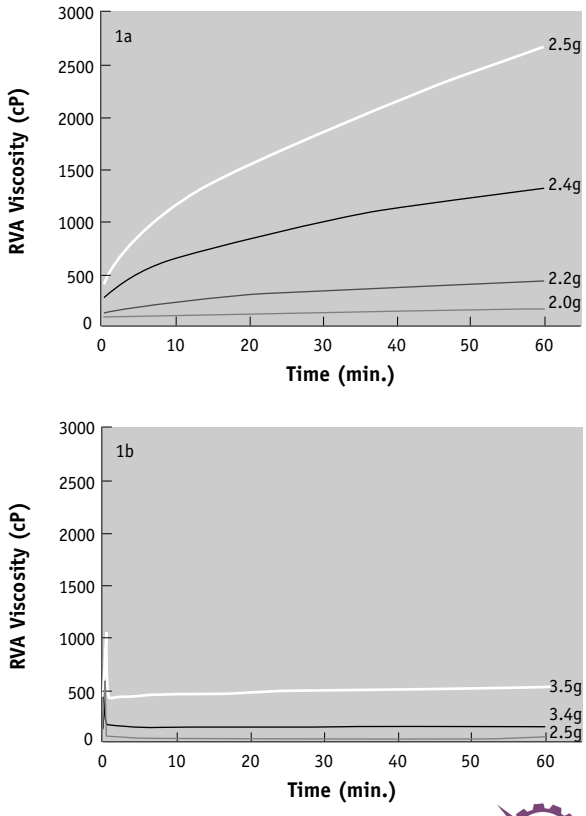
The so-called 'mixing' viscosity and 'swelling volume' were measured using:

1 synthetic particle-containing solutions of varying concentrations of sugar beet pulp (SBP) or wheat bran (WB) in 25g distilled water
2 modified *whole* pig stomach digesta (*whole* stomach digesta diluted in buffer in varying digesta:buffer ratios
3 non-modified *whole* pig digesta. Digesta were obtained from pigs fed on SBP- or WB-based diets.

'Mixing' viscosity was measured using two Rapid Visco-Analysers (RVAs) by mixing 20g samples at 160rpm.

'Swelling volume' was determined by centrifuging digesta and calculating the wet pellet to supernatant ratio (wt/wt). This ratio provides information on the volume occupied by the solid fraction of each sample.

**Figure 1**
*RVA 'mixing' viscosity of (1a) SBP and (1b) WB increased with increasing particle concentrations. The two NSPs showed different wetting behaviours in that SBP, but not WB, swelled over time.*



Newly developed methodologies for the determination of the viscous properties of *whole* digesta derived from finisher pigs fed soluble or insoluble NSP-based diets

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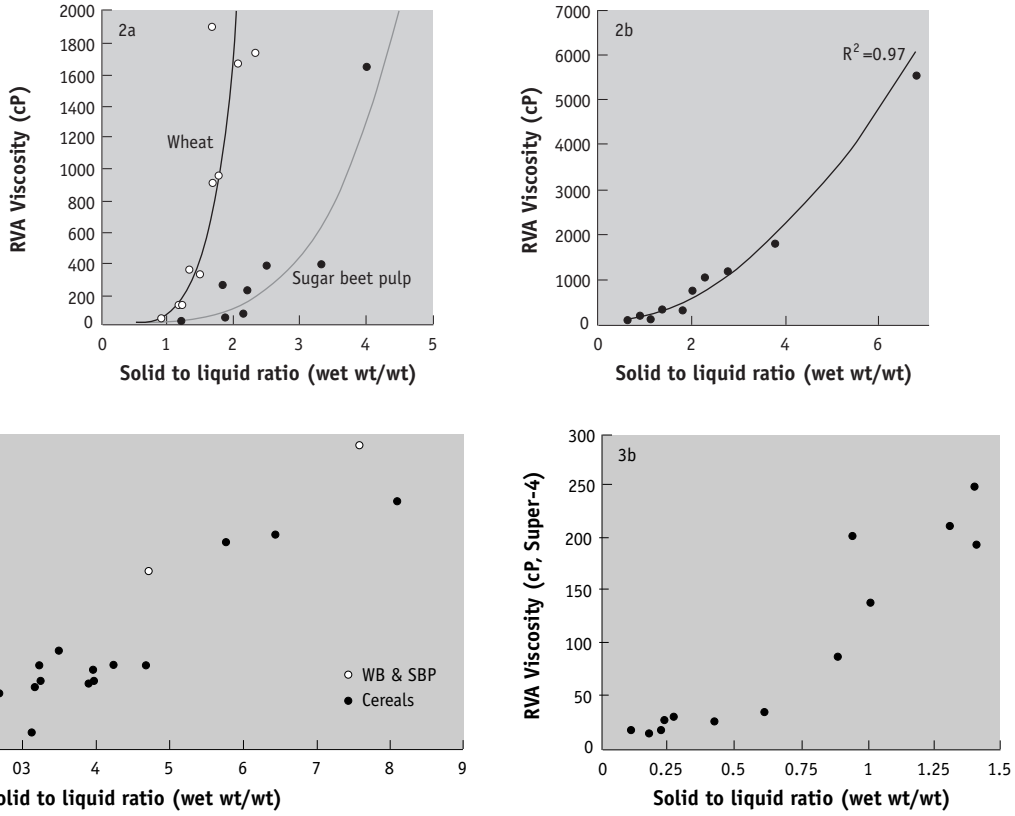


**Figure 2**
*Positive correlation between RVA 'mixing' viscosity and Solid to Liquid Ratio (Wet Wt/Wt) for (2a) synthetic WB and SBP solutions and (2b) modified (diluted) stomach samples from finisher pigs.*

**Figure 3**
*Positive correlation between RVA 'mixing' viscosity and Solid to Liquid Ratio (Wet Wt/Wt) for non-modified* whole *stomach digesta from pigs. RVA-Super4 (3b), in contrast to RVA-4 (3a), was quantitative below 200 cP.*

## CONCLUSION

Two protocols for the measurement of the viscosity of *whole* digesta have been developed and validated for the first time. Analysis of the RVA 'mixing' viscosity and 'swelling volume' of *whole* digesta, rather than the viscosity of digesta supernatants, will probably lead to a better understanding of the viscous properties of digesta and the way these characteristics may affect gastric emptying. These new protocols can be easily implemented by animal science research groups.

## ACKNOWLEDGEMENT

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