Methodologies for the assessment of volume and stability of coffee foam

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INTRODUCTION

Coffee appearance and mouthfeel are key attributes driving consumer preference. Volume, texture and stability of foam are highly appreciated quality criteria for coffee consumers. However, accurate measurement of coffee foam properties still represents a challenge.

Three methods differing in their energy input and mechanism to generate foam (i.e. whipping vs. sparging) were compared using espresso and soluble coffees. Methods A and B generated foam by whipping the solution with high energy (Method A) or medium energy (Method B). Method C created foam by slowly sparging air through a frit using low energy input. The methodologies were tested for their ability to discriminate coffees of different compositions and concentrations in terms of foamability (i.e. foam volume) and foam stability.

METHODOLOGY

Coffee extracts

Two soluble coffees were selected for their capacity to deliver foam in a cup, i.e. highly foaming (SC1) / poorly foaming (SC2). An espresso coffee (EC) was also assessed to allow comparison with soluble coffee. Coffee solutions at 0.5, 1.0 and 2.0% were prepared and incubated for 15 min at 75°C prior to the foam experiments.

Method A - High Energy / Short time

84 mL coffee extract are whipped in a mixing chamber (15’000rpm/5s). The liquid and foam parts are collected into a 100 mL cylinder. The foam and liquid volumes are determined by image analysis every 30 s over 15 min.

Method B - Medium Energy / Long time

20 mL coffee extract are whipped with a 3-pals helix (5,000 rpm) until a definite volume of foam (30 mL) was reached in the glass column. The foam volume was measured by a grey-level scale taking pictures. The liquid volume in the foam was followed by conductivity using electrodes.

Method C - Low Energy / Long time

40 mL coffee extract are poured into a glass column equipped with a 2 mm frit at the bottom. 5 mL of air are sparged at 7 mL/min during 45 s into a glass column. The foam and liquid volumes are determined by image analysis every 30 s over 15 min.

FOAM & COMPOSITION

Foaming properties of SC1, SC2, EC coffees at 1% W/W

<table>
<thead>
<tr>
<th>Method</th>
<th>Foam volume</th>
<th>Liquid drainage per ml of foam</th>
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<tbody>
<tr>
<td>SC1</td>
<td></td>
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<td>SC2</td>
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<td>EC</td>
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CONCLUSIONS

- Both methods A and B are able to discriminate coffees of differing foaming performance with similar ranking, i.e. SC1>EC>SC2 on the basis of foam volume. They could also distinguish liquid drainage rate. Methods A and B are both based on whipping technique, which provide high/medium energy to the extract for short (i.e. Method A 15’000rpm, 5s) or longer duration (i.e. Method B 5’000rpm, >50s). No redistribution of molecules at the interface is expected, which may allow differentiating the impact of coffee composition. Method A is also sensitive to the effect of extract concentration, in contrast to method B.
- Method B provides additional insight into the kinetics of foam formation. It is particularly adapted to identify coffees with poor and unstable foam such as SC2.
- On the contrary method C is poor at discriminating foaming performance. However, due to the sparging technique, it allows gentle molecular redistribution at the interface, thus limiting the direct impact of coffee composition.