Acids in brewed coffees: Chemical composition & sensory threshold

Christina J. Birke Rune, Davide Giacalone, Ida Steen, Morten Münchow, Lars Duelund & Mathias Porsmose Clausen

Presented by
Christina J. Birke Rune
cjbr@iti.sdu.dk
Background

Why talk about acidity in coffee?

Acids are key contributor to the sensory experience of coffee (Ginz et al., 2000)

Acidity of coffee is an important part of evaluating coffee quality

Acidity in coffee is considered important for the evaluation of the lighter roasted specialty coffee

Based on qualitative differences in the acidity of organic acids and difference in the coffee's chemical acid composition certified coffee specialists are purportedly able to distinguish between the coffee's geographical origin (Rivera, 2020)
Background

What have been done previously?

30 scientific papers from 1959-2020 have reported about Organic Acids in coffee - green, roasted, and brewed (Yeager et al., 2021)

Only 4 scientific papers have reported firsthand data on the Organic Acids in brewed coffee

Espresso (Khamitova et al., 2020)
Cold brew (Ahmed et al., 2019),
ISO standard (Rodrigues et al., 2007)
Different brewing conditions (grind size, brew temperature and brew time) (ICO, 1991)
Objectives

The research objectives of the study is that acid concentrations alone are insufficient to distinguish between the geographical origins of brewed coffees as other parameters such as roasting degree will have a higher influence on the acid concentrations.

Further, this objective is that not all acids in coffee are present in concentrations relevant to the human detection threshold.

Outcome

Provide scientific data on acids in brewed coffee, in order to support future sensory training for coffee experts.
Samples

<table>
<thead>
<tr>
<th>Sample origin</th>
<th>Roasting level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil 1</td>
<td></td>
</tr>
<tr>
<td>Brazil 2</td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td></td>
</tr>
<tr>
<td>Kenya 1</td>
<td></td>
</tr>
<tr>
<td>Kenya 2</td>
<td></td>
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</tbody>
</table>

Brewing
French Press
Chemical Analysis

Organic acids
Inorganic acid
Chlorogenic acids
Sugars
Roasting, but not origin, systematically changed the acid composition

Citric, malic and chlorogenic acid
↓ decreased
with increasing roast degree

Acetic, lactic, phosphoric, quinic and glucolic acid
↑ increased
with increasing roast degree

Formic acid
→ no change
with increasing roast degree
Sensory Detection Threshold

Method

Two Alternative Ascending Forced Choice (2-AFC)

N = 24 consumers

Acid selection

Based on Coffee Quality Institute (CQI) and Specialty Coffee Association (SCA) training

- Citric, malic, acetic, lactic and phosphoric

Concentrations

<table>
<thead>
<tr>
<th>Spiked</th>
<th>Blank</th>
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</thead>
<tbody>
<tr>
<td>0.16 (g/L)</td>
<td></td>
</tr>
<tr>
<td>0.20 (g/L)</td>
<td></td>
</tr>
<tr>
<td>0.25 (g/L)</td>
<td></td>
</tr>
<tr>
<td>0.31 (g/L)</td>
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</tbody>
</table>

5 test set in total
Only citric acid can clearly be detected above measured concentrations.
Recognition test

Method
N = 13 Coffee Experts

Training
The experts train regularly, also with acids
30 minutes intense training prior test

Test
According ISO standard 3972:2011

"name the acid spiked in this water/coffee", Suggestions were provided

Concentrations
0.4 (g/L) all acid
0.5 (g/L) lactic

Mean measured concentration
In Water

Only **acetic acid** was significantly recognized in *water*, at test concentrations.

In Coffee

**No acid** was significantly recognized in *Coffee*, at concentrations found in brewed coffee.
Conclusion

The concentration of individual acids systematically varies with the roasting degree for all acids.

Only citric acids varies systematically with the origin.

Recognizing the geographical origin of coffee based on organic acid content is not supported or understood from a chemical perspective.

Only citric acid can clearly be detected in concentrations above average measured concentration.

None of the five acids were significantly identified in coffee, by coffee experts.
Further Studies

All acids contribute to the overall acidity but focusing on their individual contribution to the coffee acidity appears unjustified, and indeed, it appears that other factors than acids influence the perceived acidity.

Combined, the results question the direct relation between individual organic acids and acidity in coffee and point towards a broader understanding of perceived acidity.
References

Ginz et al., 2000: https://doi.org/10.1007/s002170000215

Rivera, 2020: https://www.roastmagazine.com/issues/100

Yeager et al., 2021: https://doi.org/10.1080/10408398.2021.1957767

Khamitova et al., 2020: https://doi.org/10.1016/j.foodres.2020.109220

Ahmed et al., 2019: https://doi.org/10.1002/jsfa.9186

Rodrigues et al., 2007: https://doi.org/10.1016/j.jfca.2006.08.005

Thank you for your time!

Contact information

e-mail: cjbr@iti.sdu.dk

LinkedIn: Christina J. Birke Rune

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