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Comparison of the group thresholds of Capsaicin depending on the matrix[1]

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Summary

The present study using the 3-Alternative Forced Choice method showed significant different thresholds for capsaicin in aqueous and oil based solutions. The threshold for capsaicin in oil is about the factor ten higher than the threshold in water.

Keywords: Capsaicin, water, oil, threshold, 3-AFC, taste, sensing

Introduction and research question

Capsaicin is the most important compound found in chili (*Capsicum annuum*) that provides oral sensation of heat [1]. Pungency intensity and duration, however, are influenced by the food matrix [2].

Thus the objective of this study was to determine the pungency detection thresholds for capsaicin in aqueous and oil based solutions in the area of the mouth and the throat.

Method

Pungency detection thresholds of capsaicin (producer: Sigma-Aldrich, > 95 %) in aqueous (using the emulsifier polysorbate 80 to solvate the capsaicin) and oil based solutions were measured and compared using a 3-Alternative Forced Choice sensory test (3-AFC) according to ISO 13301 [3].

Twenty-one students participated in the study. Test samples (5 mL) contained ascending concentrations of capsaicin in aqueous and oil based solutions (sunflower oil). The concentrations of the series in water increased in 2-unit steps, in oil in 3-unit steps.

Five rows of three samples in ascending concentrations – one test sample (containing capsaicin) and two reference samples (water containig polysorbate 80 or sunflower oil only) – were presented to the panelists [3]. The panelists were instructed to taste each sample and to identify the different sample in the sets of three at each concentration. If the panelists felt uncertain, they were told to guess according to the forced choice principle. Experimental setup is also shown in ◆ Figure 1.

Furthermore subjects filled out a simple questionnaire on metadata and the frequency of ingestion of pungent products.

Thresholds were calculated using the Best Estimate Threshold (BET)-method [3]. Furthermore an Analysis of Variance (ANOVA) was performed.

Result

The group BETs for capsaicin were 0.080 ppm in aqueous and 0.826 ppm in oil solutions (◆ Figure 2). ANOVA showed that the threshold in water was significant lower ($p < 0.01$) than in oil based solutions.

Using the questionnaire, in this study 12 subjects were classified as "eaters" and 9 as "non eaters". Because of the low number of panelists a cluster analysis was not performed.

Discussion

Our results are consistent with the results of Lawless et al. who also reported lower thresholds for capsaicin in water (0.310 ppm) than in oil (11.75 ppm) [4]. The clear differences between these thresholds and our calculated thresholds could probably be explained by the different study methods used. In our study the panelists were instructed to swallow the sample, while in the study of Lawless et al. [4] the panelists were presumably instructed to expectorate the sample after "swirling" the sample around in the mouth. Rentmeister-Bryant and Green [5] confirm the thesis, that the threshold for the throat is lower

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than the threshold for the tongue. Our results are furthermore consistent with other studies, in which the BET for capsaicinoid content in water (0.05 ppm) was determined. In this study, the panelists swallowed the samples, too [6].

Different studies show a decreasing response to heat intensity with an increasing fat level [2, 7]. The idea is that the hydrophobic capsaicin resolves better in an oily carrier than in water and so less capsaicin interacts with the trigeminal receptors in the oral cavity, while the hydrophilic water is not able to solve capsaicin [2, 8]. One more explanation for the more intensive perception of capsaicin in water is the less complexity of water and the fact that no other interactions with other ingredients occur [8].

However, other working groups could not confirm that a higher fat content could produce greater burn reduction evoked by capsaicin [9, 10]. One possible reason for this could be that the oral irritant is suppressed in an oily carrier, a prior triggered stimulus, however, could not be suppressed, because of the capsaicin-receptor-interaction.

Because of the small group sizes a bigger study is planned to determine differences between "chili eaters" and "non chili eaters", too.

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Conflict of Interest
The authors declare no conflict of interest according to the guidelines of the International Committee of Medical Journal Editors.

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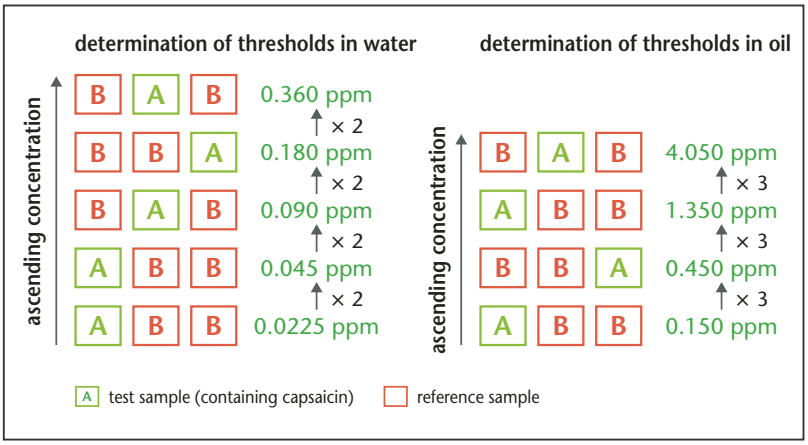

Fig. 1: **Experiment design of the 3-AFC-sensory test; determination of thresholds in water (left hand) and oil respectively (right hand)**
3-AFC-Test = 3-Alternative-Forced-Choice-Test

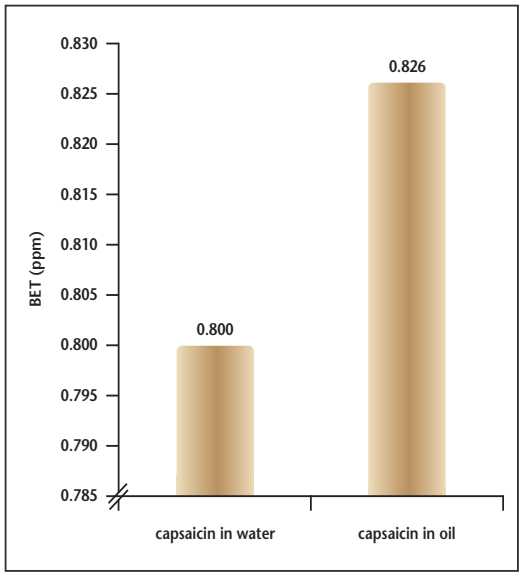

Fig. 2: **Comparison of the group BETs (geometric mean in ppm) for capsaicin in water and oil**
BET = Best-Estimate-Threshold

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