Application of Automated Facial Expression Analysis and Qualitative Analysis to Assess Emotional and Descriptive Responses to Off-Flavors in Milk Beverages

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Introduction

- Automated facial expression analysis (AFEA) is a prospective tool for consumer acceptability methodology.
- AFEA may be useful for identifying off-flavor development readily overwhelms fresh milk flavor and influences product acceptability.

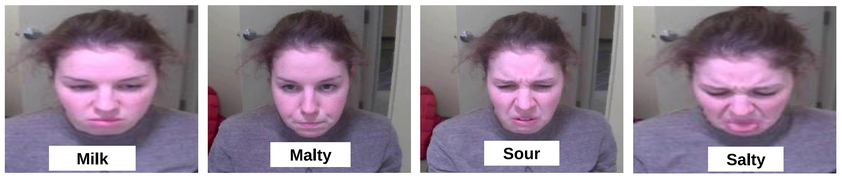
Hypothesis and Purpose

- We hypothesized that participants would elicit stronger facial expressions of emotions with intensified flavors with more negative emotional response to off-flavors.
- The purpose of our study was to characterize implicit emotions using AFEA, as related to product acceptability, and self-reported descriptors associated with milk off-flavors.

Materials and Methods

- Intensified dairy solutions were prepared using 2% milk using off-flavors from *Clark, S., Costello, M., Drake, M., and Bodyfelt, F., The Sensory Evaluation of Dairy Foods, 2nd Ed.*
- Panelists (n=49) evaluated the respective samples for hedonic liking (9 point scale) and were video-recorded for AFEA analysis.
- Videos were evaluated for emotional response using continuous analysis setting (Intensity Scale: 0=not expressed to 1=fully expressed).
- For AFEA analysis, sequential paired nonparametric Wilcoxon tests were performed between control (milk) and treatments based on the 30 Hz AFEA sampling rate. Results were translated into time series graphs for 10 sec post-consumption. Separately, hedonic data was analyzed using ANOVA and Tukey's HSD used for mean separation (α=0.05).

Figure 1. Selected facial expressions induced by respective samples of unflavored and flavored milk.



Consumer Acceptability Results

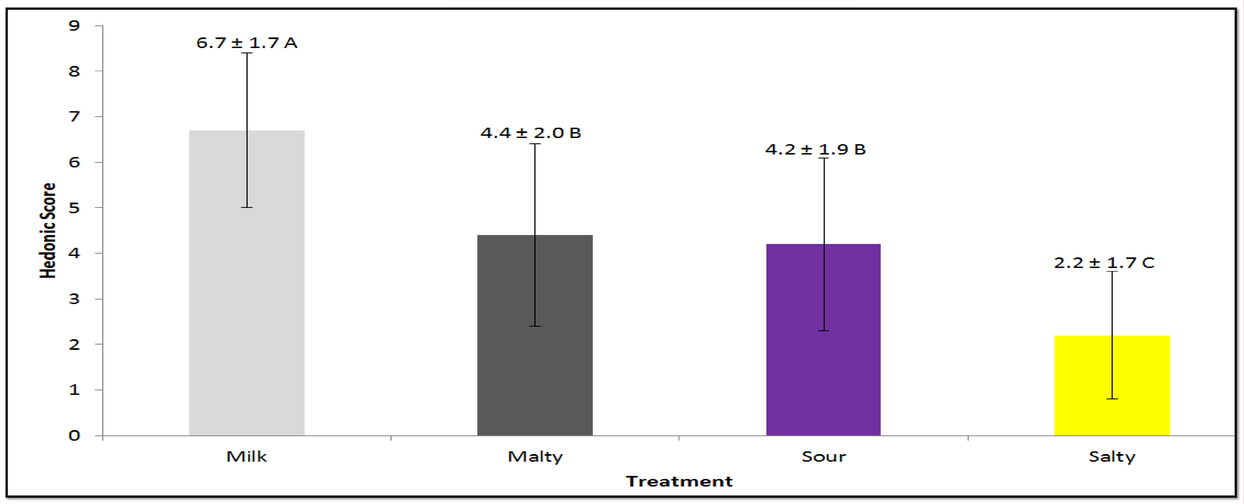


Figure 2. Product acceptability mean (hedonic scores) for each treatment (1 = "dislike extremely", 5 = "neither like, nor dislike", 9 = "like extremely").

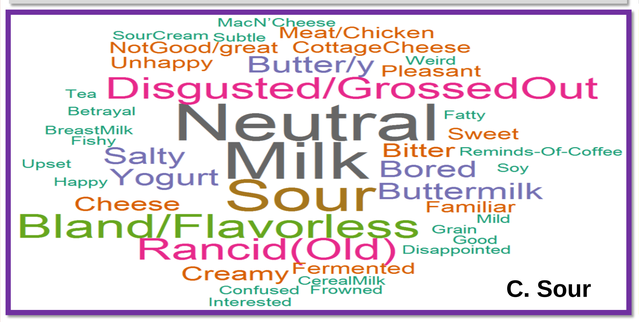


Figure 3. Participants' self-reported product descriptive terms.

Emotional Time Series Results

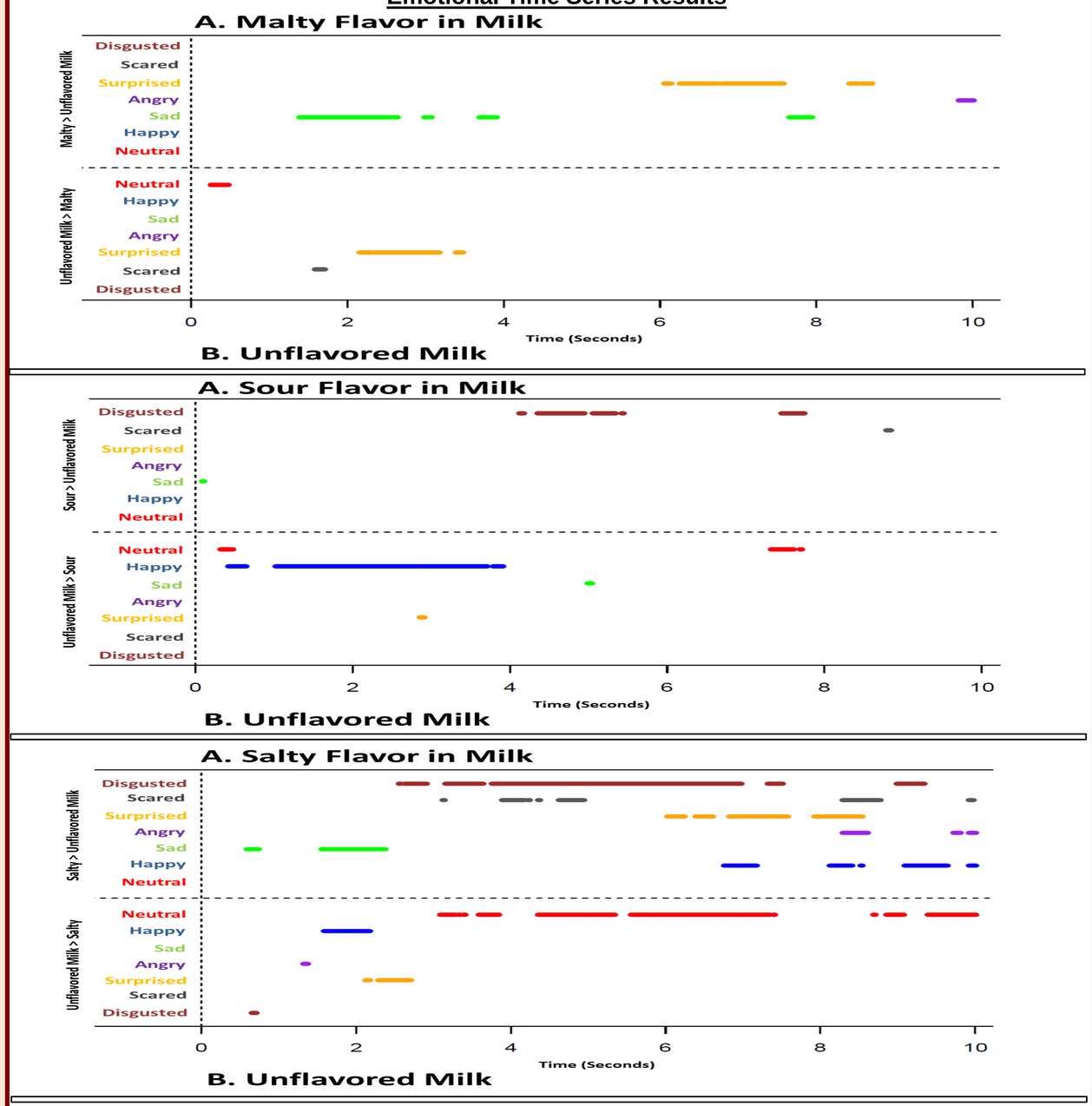


Figure 4. Selected time series data over 10 sec comparing unflavored and flavored milk for automated facial expression analysis for each emotion.

Results and Discussion

- Unflavored-milk was rated as acceptable ($p<0.05$) with "milk" (n=49) and "plain" (n=20) descriptors.
- Malty and sour were rated as disliked slightly ($p>0.05$).
- Both malty and sour descriptors included "milk" (n=12) with "cereal-milk" (n=10) and "sour" (n=10) respectively.
- Salty was disliked moderately ($p<0.05$) with "salty" (n=26) and "sour" (n=11) descriptors.
- Sad and surprised expressions were present for malty and salty in contrast to the unflavored-milk ($p<0.025$).
- Sour, malty- and salty-flavored milk elicited less neutral expression compared to unflavored-milk ($p<0.025$).
- Salty-flavored milk generated more intense sad, disgust, happy, and scared expressions of emotion than did unflavored-milk ($p<0.025$).

Significance and Conclusions

- Self-reported descriptive terms and emotions expressed through AFEA time series trends may assist in describing the impact of off-flavored milk products on milk acceptability.
- The methodology may aid with implicit and explicit consumer acceptability responses to provide further product insight and estimation of shelf-life quality.

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