Physical and sensory effects of different emulsifiers and vegetable oils in model beverage emulsions

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Background and aims

Background

- Increased consumer demand for products with healthier and more sustainable ingredients, without compromising in sensory pleasure
- Industry aiming to replace conventional vegetable oils and emulsifiers with alternative plant based options in beverage emulsions
- Physical measurements such as tribology and particle size shown to relate to certain sensory attributes in various food & beverage systems[1-3]

Aims

- To evaluate whether sensory differences can be perceived in model warm beverage emulsions with different ingredient modifications
- To determine if tribology and particle size distribution can differentiate samples with different ingredient modifications
- To explore whether physical measurements can help explain sensory perception of the samples

Methods

Sample preparation: 12 samples

- **Vegetable oils**: rice bran, coconut, fully hydrogenated vegetable oil
- **Emulsifiers**: monoglyceride, sunflower lecithin, pea protein, rice protein

Fig 1: Flow chart of sample preparation method

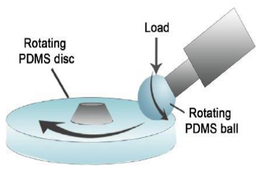
Mix — Heat treatment — Homogenise

Sensory evaluation

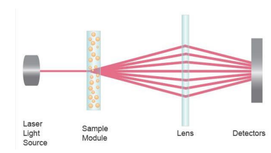
Fig 2: Picture of sensory evaluation (Quantitative descriptive analysis)

Physical measurements

Fig 3: Schematic diagram of tribometer and laser diffraction theory



Tribology[4]

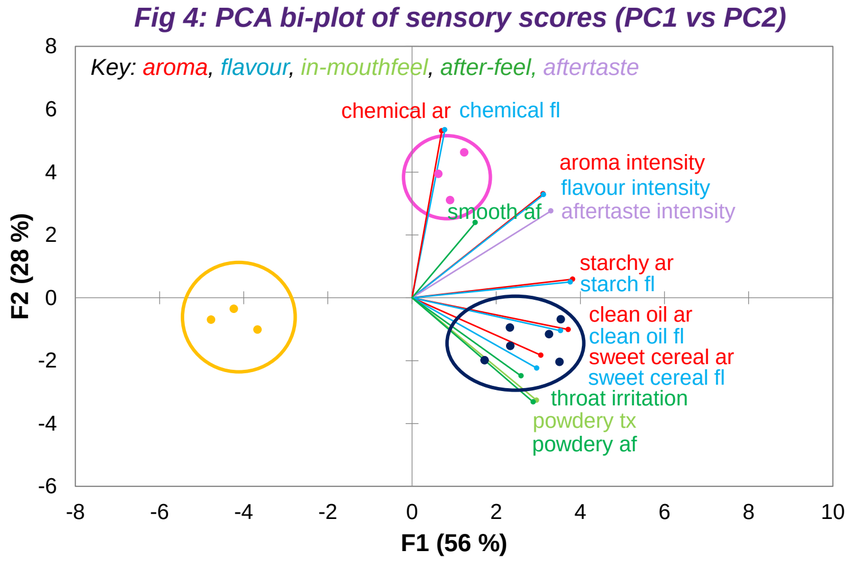


Particle size distribution[5]

Results and Discussion

Sensory evaluation

Fig 4: PCA bi-plot of sensory scores (PC1 vs PC2)



- Samples clustered into 3 groups based on emulsifier:

Group 1: monoglyceride

- Neutral aroma, flavour, and mouthfeel

Group 2: sunflower lecithin

- High ***aroma, flavour,*** and ***aftertaste intensity***
- Strong ***chemical*** aroma and flavour
- Provides ***smooth*** mouthfeel

Group 3: plant proteins

- High ***aroma, flavour,*** and ***aftertaste intensity***
- Strong ***starchy, cereal,*** and ***clean oil*** aromas and flavours
- Very ***powdery*** mouthfeel and high ***throat irritation***

Physical measurements

Fig 5: Stribeck curves of emulsions with different emulsifiers at 37ºC and 55ºC

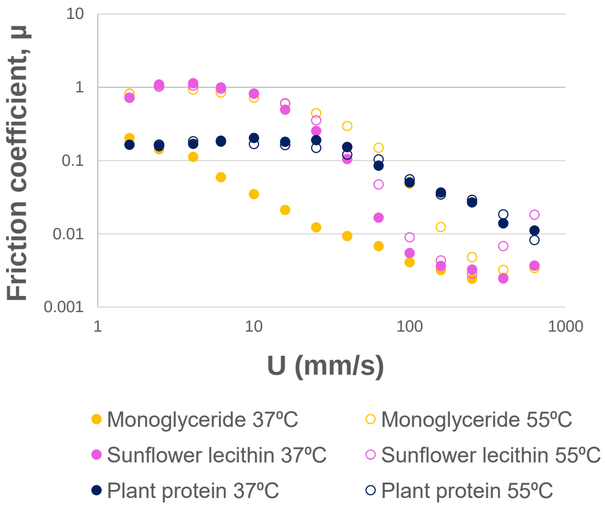
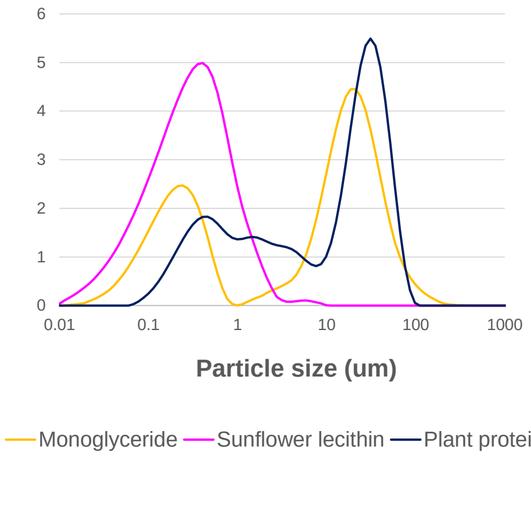


Fig 6: Particle size distribution plot of emulsions



- Samples behaved differently based on the 3 groups of emulsifiers

Group 1: monoglyceride

- Friction behaviour impacted by temperature, destabilises to oil phase (lower friction) at 37ºC
- Large, soft particles observed

Group 2: sunflower lecithin

- Friction behaviour not impacted by temperature, remains stable in aqueous phase
- Smallest particle size

Group 3: plant proteins

- Friction behaviour not impacted by temperature, but is neither oil or aqueous phase, due to hard particles and oily surface (not fully emulsified)
- Large, hard particles observed

Conclusions

- Emulsifier type had greater impact on sensory and physical properties than vegetable oil type
- Monoglyceride had neutral sensory properties, and not perceived to be powdery, despite having large, soft particles
- Sunflower lecithin perceived to be smoothest after swallowing, due to small particle size and ability to remain stable in aqueous phase in tribology, but has a strong unpleasant aroma and flavour
- Plant proteins had strong cereal & clean oil aromas & flavours, but also large, hard particles, resulting in powdery sensation,

Future work

- Increase complexity of model emulsions by adding additional ingredients typical in beverage emulsion products
- Explore how ingredients interact with saliva in influencing mouthfeel properties

References

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