

Supplementary Materials

Table S1. Index flow, consistency and shear thinning effect from 50 to 300 s⁻¹ for daily condition (DC) doses.

| DC doses | | | |
|--|-------------------------|-----------------|--------------------|
| Target viscosity (mPa·s) at 50 s ⁻¹ | Index flow (<i>n</i>) | Consistency (K) | Shear thinning (%) |
| 100 | 0.29 | 3.1 | 77.1 |
| 200 | 0.19 | 3.7 | 76.5 |
| 400 | 0.16 | 4.0 | 78.0 |
| 800 | 0.16 | 4.3 | 77.8 |
| 1600 | 0.17 | 4.6 | 77.2 |

DC: Daily condition.

Table S2. Viscosity values (mean±SD) by standing time for 200 and 800 mPa·s; *p* > 0.05 (ns).

| Standing time (min) | 200 mPa·s (Target viscosity at 50 s ⁻¹) | | | 800 mPa·s (Target viscosity at 50 s ⁻¹) | | |
|---------------------|---|---------------------------|-----------------|---|---------------------------|-----------------|
| | Viscosity (mPa·s) at 50 s ⁻¹ (mean±SD) | Differences 0-120 min (%) | <i>p</i> -value | Viscosity (mPa·s) at 50 s ⁻¹ (mean±SD) | Differences 0-120 min (%) | <i>p</i> -value |
| 0 | 183.3±11.0 | | | 848.2±38.4 | | |
| 30 | 177.0±9.0 | | | 827.1±42.7 | | |
| 60 | 169.5±8.3 | 16.6 | 0.46 | 784.9±32.7 | 10.2 | 0.054 |
| 90 | 167.5±15.3 | | | 809.4±38.4 | | |
| 120 | 152.9±19.1 | | | 762.1±39.4 | | |

| Standing time (min) | 200 mPa·s (Target viscosity at 50 s ⁻¹) | | | 800 mPa·s (Target viscosity at 50 s ⁻¹) | | |
|---------------------|---|---------------------------|-----------------|---|---------------------------|-----------------|
| | Viscosity (mPa·s) at 300 s ⁻¹ (mean±SD) | Differences 0-120 min (%) | <i>p</i> -value | Viscosity (mPa·s) at 300 s ⁻¹ (mean±SD) | Differences 0-120 min (%) | <i>p</i> -value |
| 0 | 42.1±2.0 | | | 166.0±35.3 | | |
| 30 | 41.1±1.5 | | | 157.7±5.9 | | |
| 60 | 38.5±0.3 | 14.9 | 0.051 | 159.2±3.1 | 3.9 | 0.40 |
| 90 | 39.2±2.2 | | | 159.4±2.3 | | |
| 120 | 35.8±3.9 | | | 159.6±2.9 | | |

Table S3. Viscosity values (mean±SD) by increasing temperature from 20°C to 40°C for 200 and 800 mPa·s levels for daily conditions doses; *p*>0.05 (ns).

| Temperature (°C) | 200 mPa·s (Target viscosity at 50 s ⁻¹) | | | 800 mPa·s (Target viscosity at 50 s ⁻¹) | | |
|------------------|---|------------------------|-----------------|---|------------------------|-----------------|
| | Viscosity (mPa·s) at 50 s ⁻¹ (mean±SD) | Differences 0-40°C (%) | <i>p</i> -value | Viscosity (mPa·s) at 50 s ⁻¹ (mean±SD) | Differences 0-40°C (%) | <i>p</i> -value |
| 20 | 190.2±6.5 | | | 848.2±38.4 | | |
| 25 | 180.5±5.8 | | | 827.1±42.7 | | |
| 30 | 185.3±15.3 | 6.3 | 0.17 | 784.9±32.7 | 5.9 | 0.09 |
| 35 | 181.6±5.6 | | | 809.4±38.4 | | |
| 40 | 178.1±8.9 | | | 762.1±39.4 | | |

| Temperature (°C) | 200 mPa·s (Target viscosity at 50 s ⁻¹) | | | 800 mPa·s (Target viscosity at 50 s ⁻¹) | | |
|------------------|---|------------------------|-----------------|---|------------------------|-----------------|
| | Viscosity (mPa·s) at 300 s ⁻¹ | Differences 0-40°C (%) | <i>p</i> -value | Viscosity (mPa·s) at 300 s ⁻¹ | Differences 0-40°C (%) | <i>p</i> -value |
| 20 | 42.1±2.0 | | | 166.0±35.3 | | |
| 25 | 41.1±1.5 | | | 157.7±5.9 | | |
| 30 | 38.5±0.3 | 14.9 | 0.051 | 159.2±3.1 | 3.9 | 0.40 |
| 35 | 39.2±2.2 | | | 159.4±2.3 | | |
| 40 | 35.8±3.9 | | | 159.6±2.9 | | |

| | (mean±SD) | | | (mean±SD) | | |
|----|-----------|-----|------|-------------|-----|------|
| 20 | 42.4±3.1 | | | 166.03±5.34 | | |
| 25 | 39.7±0.9 | | | 157.70±5.90 | | |
| 30 | 42.8±2.2 | 7.0 | 0.20 | 159.23±3.10 | 5.8 | 0.11 |
| 35 | 42.0±1.9 | | | 159.43±2.27 | | |
| 40 | 39.4±0.3 | | | 159.57±2.87 | | |

Table S4. Index flow, consistency and shear thinning effect from 50 to 300 s⁻¹ for VFS doses.

| VFS doses | | | |
|--|-------------------------|-----------------|--------------------|
| Target viscosity at 50 s ⁻¹ (mPa·s) | Index flow (<i>n</i>) | Consistency (K) | Shear thinning (%) |
| 100 | 0.32 | 3.1 | 70.2 |
| 200 | 0.23 | 3.7 | 75.5 |
| 400 | 0.16 | 4.1 | 77.4 |
| 800 | 0.16 | 4.4 | 78.1 |
| 1600 | 0.18 | 4.6 | 77.0 |

VFS: videofluoroscopy.

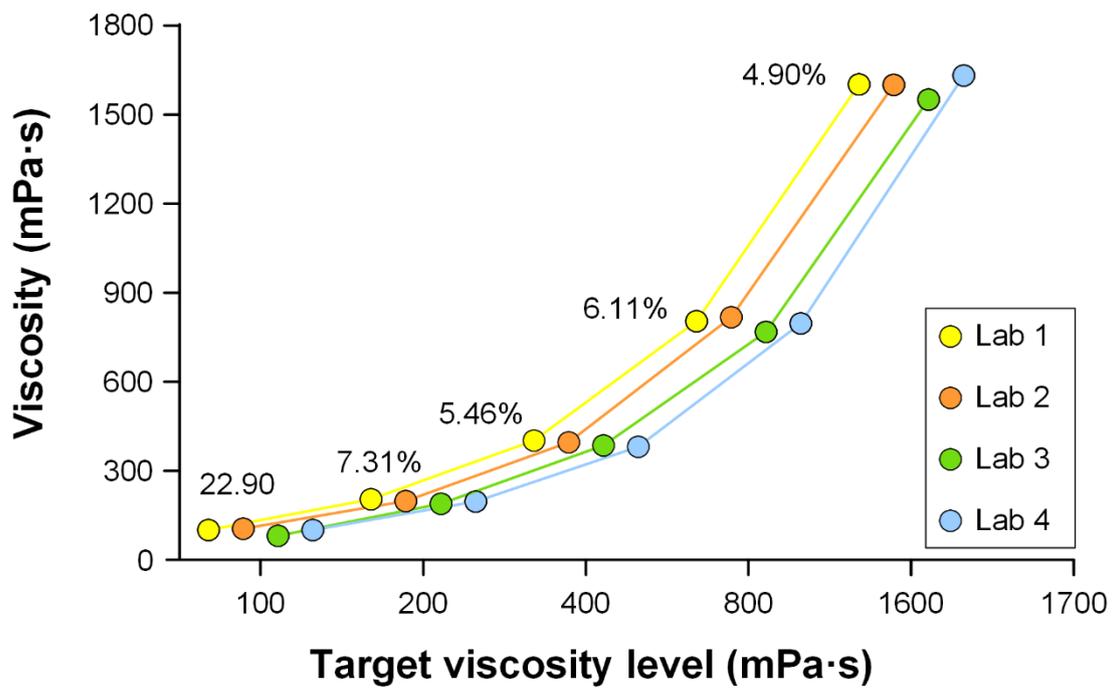


Figure S1. Inter-laboratory variability for each shear viscosity level tested (100, 200, 400, 800 and 1600 mPa·s).

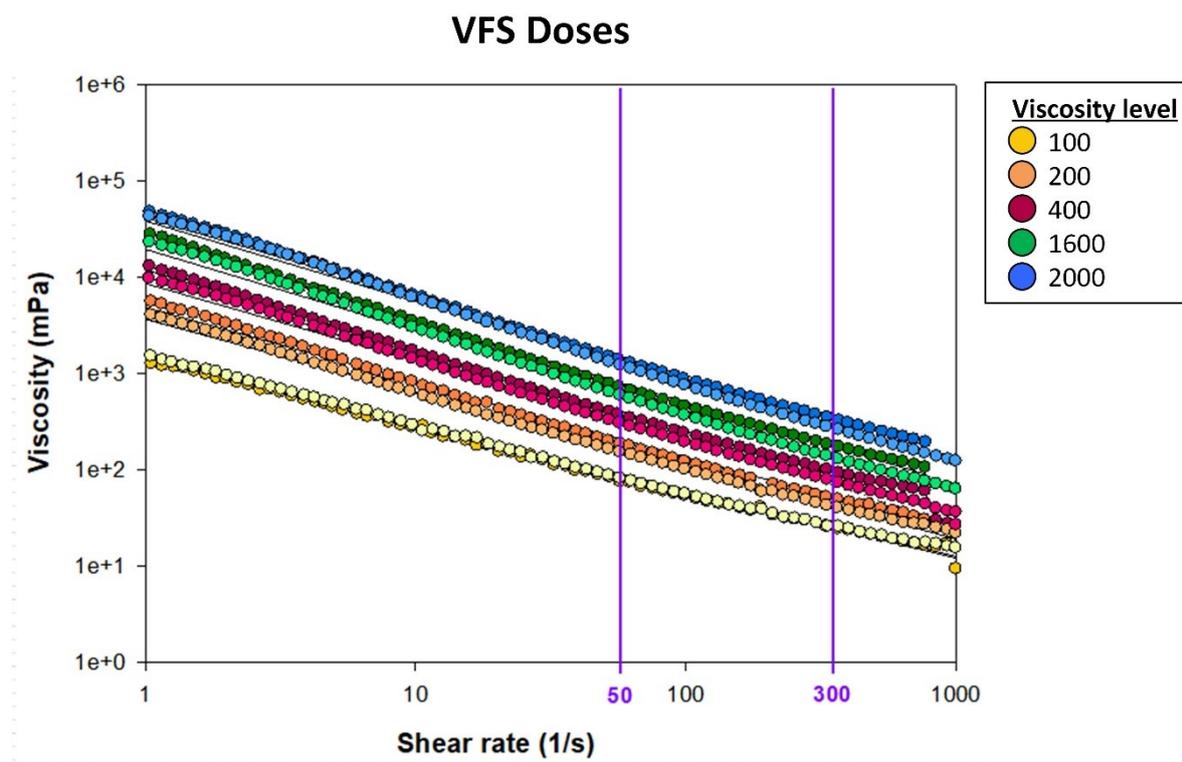


Figure S2. Viscosity curves from a shear rate range of 1–1000 s^{-1} for videofluoroscopy doses before and after oral incubation in healthy volunteers. Dark colors correspond to viscosity levels pre-oral incubation. Soft colors correspond to viscosity post-oral incubation. Purple lines mark the two main shear rate landmarks (50 and 300 s^{-1}) during deglutition in patients with oropharyngeal dysphagia.

Supplementary Information S1: Normalized protocol to determine shear viscosity for thickening

1. Material and equipment

- Solvent: thickening product
- Dissolvent: mineral water, alimentary fluid, X-ray contrast
- Equipment to measure shear viscosity: viscometer or rheometer
- Stirrer: Metallic spatula
- Container: Glass beakers or clear plastic cups
- Chronometer
- Plastic Syringe (minimal volume: 20 mm)

2. Participants

In order to perform the *ex vivo* salivary amylase effect, participants will be needed to

3. Preparation mode

- a) Weigh the dissolvent in a clear plastic cup
- b) Weigh the solvent in another cup
- c) Initiate the chronometer and add the solvent to the dissolvent over 5 s while stirring at 4 rps with a metallic spatula
- d) Continue stirring for 30 s at the same velocity

- e) Leave the prepared sample resting for 10min

3. Sample analysis

In vitro shear rate effect

- f) Analyze viscosity by increasing shear rate from 0 to 1000 s⁻¹ in a 10 minute test at 25°C
- g) Interpolate the viscosity values at 50 and 300 s⁻¹ to obtain the apparent viscosity value in the oral and pharyngeal phase, respectively
- h) Repeat the process from step 'a' to 'e' two times more to obtain triplicates

Ex vivo salivary amylase effect

- f) Volunteer / patient preparation: give to the patient water to clean the mouth performing intra-oral movements for 10 s. Remove the water.
- g) Take 15 ml of the prepared sample with a plastic syringe and give it to the volunteer / patient. Ask them to maintain the sample in the oral cavity by performing intra-oral movements for 30s and then to spit it
- h) Analyze viscosity by increasing shear rate from 0 to 1000 s⁻¹ in a 10 minute test at 25°C
- i) Interpolate the viscosity values at 50 and 300 s⁻¹ to obtain the apparent viscosity value in the oral and pharyngeal phase, respectively
- j) Repeat the process from step 'a' to 'e' two times more to obtain triplicates
- k) Repeat the process for the needed number of participants