Unique Physical Properties of an Oral Super Absorbent Hydrogel Compared to Common Fiber Supplements

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INTRODUCTION

A non-systemic oral superabsorbent hydrogel (OSH) has been FDA-cleared as Plenity®, a prescription aid in weight management for adults with excess weight or obesity (BMI 25-40kg/m²) when combined with diet and exercise. OSH is made of carboxymethylcellulose cross-linked with citric acid. OSH absorbs water in a three-dimensional matrix forming non-clustering, firm pieces of gel, promoting fullness and satiety **(Figure 1)**. In contrast, soluble fibers are linear, non-cross-linked, and form a viscous fluid when hydrated. Some soluble fibers are promoted as supplements to provide fullness and weight loss. This *in vitro* study was conducted to evaluate the physical property differences between OSH and fiber supplements.

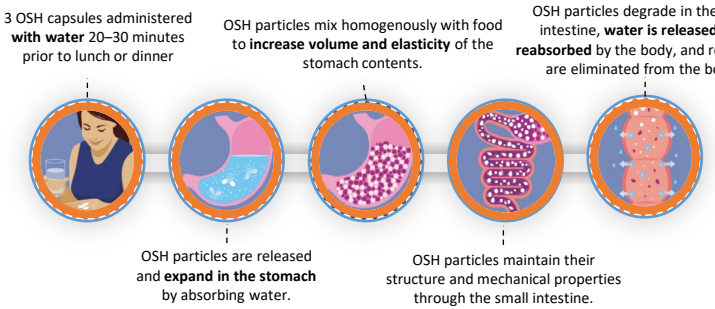

Figure 1. Mechanism of action: OSH particles in the GI tract.

METHODS

OSH and the following commercially-available fiber supplements were tested: glucomannan, guar gum, psyllium, methylcellulose, wheat dextrin, inulin, and calcium polycarbophil. Samples (triplicate) in a 1:1 ratio were hydrated in a 1:8 mixture of simulated gastric fluid (SGF) and water to mimic digestion. The physical properties evaluated for each sample were: 1) water absorption capability and 2) elasticity.

Water absorption capability, also known as media uptake ratio (MUR), is a measure of how much water each sample is able to absorb. Water absorption capability was evaluated by incubating 0.25g of the sample (OSH or fibers) in 40 mL of SGF/water mixture at 25°C for 30 minutes, under gentle stirring. The sample was then collected, drained on a filter to eliminate excess water, and weighed. MUR was calculated by comparing the final weight of the hydrated sample with the initial weight of the dry sample **(Figure 2)**.

Dynamic-mechanical analysis (DMA) using a rotational rheometer was used to determine the elasticity (modulus G'), or firmness, of each hydrated sample. **(Figure 3)**. Analysis of variance (ANOVA) and Fisher's PLSD were performed to test for differences.

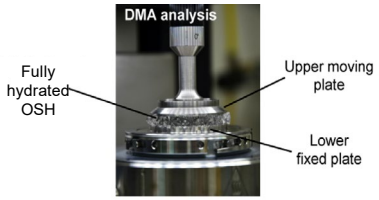

Figure 3. A rotational rheometer measured the firmness of each hydrated sample.

RESULTS

Figure 2. Visual comparison of OSH and common fiber supplements following hydration.

Glucomannan and guar gum demonstrated the highest water absorption capability (138.3±2.1 and 134.7±1.2 g/g), followed by OSH (76.8±0.6), psyllium (17.7±0.6), and methylcellulose (2.7±0.6) ($p<0.01$ for all) **(Figure 4).**

Wheat dextrin, inulin, and calcium polycarbophil exhibited no absorption capability.

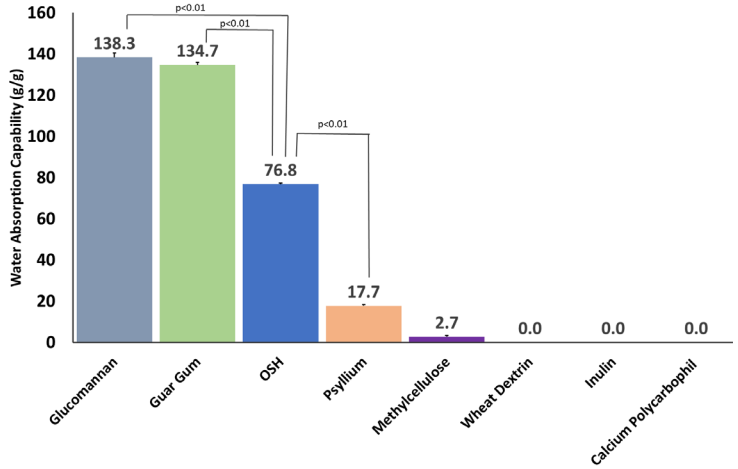

Figure 4. Water absorption capability of OSH and common fiber supplements.

OSH exhibited the highest elasticity (1451.0±64.8 Pa), followed by psyllium (145.3±13.2), glucomannan (9.0±0.2), and guar gum (4.4±3.1) ($p<0.001$) **(Figure 5)**. The elasticity levels for methylcellulose, wheat dextrin, inulin, and calcium polycarbophil were below measurable levels.

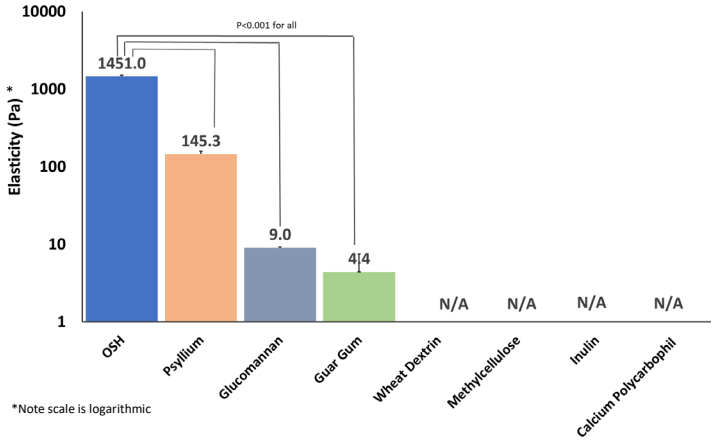

Figure 5. Comparison of elasticity following hydration of OSH and common fiber supplements.

CONCLUSIONS

- The oral superabsorbent hydrogel exhibited unique physical properties with a combination of high elasticity (firmness) and high water absorption capability (increased volume).
- The unique combination of high elasticity and water absorption capability distinguishes OSH from common fiber supplements and may provide insight into its weight loss mechanism.

DISCLOSURES

JG is on the speakers bureau for Novo Nordisk, Sanofi, Xeris, Lilly, Amarin. EP, DB, MM, CD, and AS are employees of Gelesis.