

# Evaluation of the Mucoadhesive Properties of PCCA Ellage™

## Part 1: Ex Vivo Bioadhesion Testing Using a Texture Analyzer

**SUMMARY:** The bioadhesion testing on porcine vaginal tissues evaluates the ability of the test formulations to adhere to *ex vivo* biological surfaces. A comparative study was conducted by testing simultaneously the new PCCA Ellage versus MucoLox™/VersaBase® Gel (50:50) and an OTC long-lasting vaginal moisturizer. The three test products exhibited similar bioadhesion (differences not statistically significant), as opposed to the negative control. It is concluded that PCCA Ellage Anhydrous Vaginal has a good bioadhesion profile.

### Introduction:

The vaginal mucosa offers a large surface area and rich blood supply making it a promising site for delivery of medication but it faces a multitude of challenges; in particular, the leakage potential of drugs due to the vaginal fluid that is continuously released [1]. Mucoadhesion is widely recognized as an important property in vaginal drug delivery and there are various analytical methods for the *in vitro* / *ex vivo* evaluation of the mucoadhesive properties of vaginal semisolid formulations. Bioadhesion, in particular, represents the ability of a formulation to adhere to a biological surface (e.g., *ex vivo* vaginal epithelium) and it is measured by the tensile force or work of adhesion using commercially available texture analysers, as the example shown in Figure 1 [2-3].

The aim of this study was to evaluate the bioadhesion properties of PCCA Ellage using porcine vaginal tissues. A comparative study was conducted by testing simultaneously the well-established combination MucoLox/VersaBase Gel (50:50) and the over-the-counter (OTC) vaginal moisturizer of reference that claims to be long-lasting (up to 3 days).

### Methodology:

Frozen *ex vivo* porcine vaginal tissues were obtained from BioIVT (Westbury, NY) and reserved in an airtight bag at -20°C. A Vaginal Fluid Simulant (VFS) was prepared to model the fluid produced in the human vagina by healthy, nonpregnant premenopausal women [4]. Prior to the experiment, the vaginal tissues were thawed at room temperature and cut to excise the epithelium surface. Using a biopsy scalpel punch, the vaginal epithelia was further cut into a surface area of approximately 10-mm diameter.

The bioadhesion testing was evaluated using the CTX Texture Analyzer (Ametek Brookfield, USA) equipped with a load cell of 1.5 Kg (Figure 1). The three test products [PCCA Ellage, MucoLox/VersaBase Gel (50:50) and the OTC vaginal moisturizer] were premixed with the VFS. For each experiment, a sample of 0.05 mL of test product in VFS was added to the cellulose acetate membrane, which was fixed to the texture analyzer using a mucoadhesion rig. A total of 6 replicates were carried out per test product. A negative control was used by adding 0.05 mL of VFS to the cellulose acetate membrane. All experiments were conducted at the body temperature of 37°C.

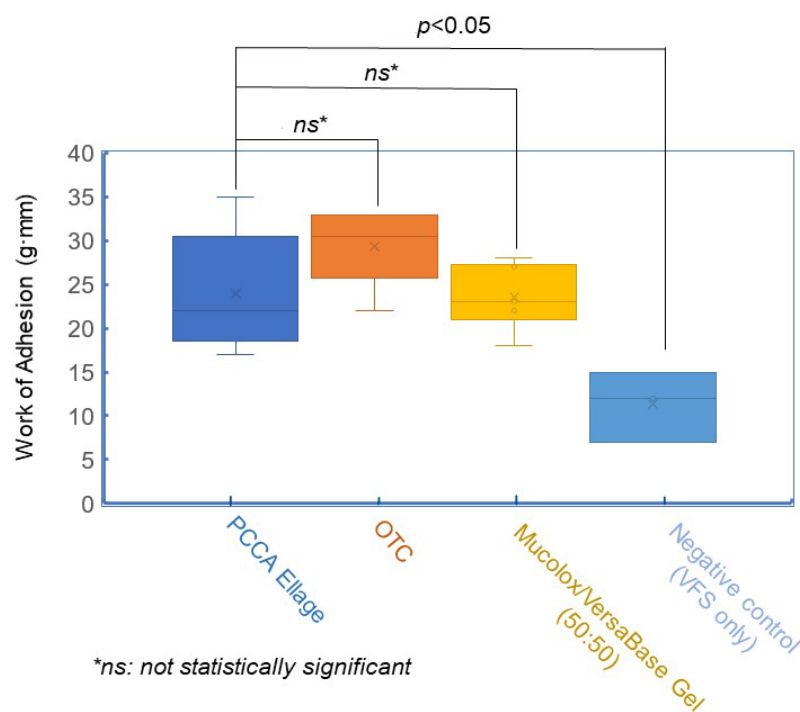
The porcine epithelia was attached to the cylinder probe of the texture analyzer using cyanoacrylate glue. For each experiment, the cylinder probe was lowered at a speed of 2.5 mm/min using a trigger force of 1 g, followed by a force of 60 g to bring the epithelia into contact with the test product. The contact/hold time between the porcine epithelia and the test product was 3 min. The cylinder probe was then lifted at a speed of 2.5 mm/min to separate the epithelia from the test product. The work of adhesion (g·mm) was calculated as the area under the force *versus* the displacement curve.



**Figure 1.** CTX Texture Analyzer (Ametek Brookfield, USA) equipped with a load cell of 1.5 Kg.

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**Figure 2.** Box plot: work of adhesion for the three test products and the negative control:

Each box represents the values between the first and the third quartile.

The whiskers represent the distances between the minimum and maximum work of adhesion obtained for the 6 replicates.

The median is shown as a line and the calculated average is shown as a cross within each box.

### Results & Discussion:

The average work of adhesion obtained for each test product (6 replicates) is very similar, as follows: PCCA Ellage  $24 \pm 6.78$  g·mm; MucoLox/VersaBase Gel (50:50)  $24 \pm 3.62$  g·mm; and OTC  $29 \pm 4.23$  g·mm. These differences are not statistically significant which demonstrate that PCCA Ellage has a good bioadhesion profile, similar to the well-established combination MucoLox/VersaBase Gel (50:50) and the OTC long-lasting vaginal moisturizer. The standard deviations obtained are likely due to variations of the excised epithelium surface.

In contrast, the work of adhesion for the negative control is much lower ( $11 \pm 4.04$  g·mm) and it is statistically significant ( $p < 0.05$ ), which shows that the VFS alone has minimum bioadhesion. Despite its limitations, this analytical method is a valuable, reliable and reproducible tool to determine the mucoadhesive properties of vaginal semisolid formulations.

### References:

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