

## Influence of different concentration of polysorbate 20 and carbomer on suspension structure

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### Introduction

Topical suspensions represent two-phase system (solid phase dispersed in liquid) which is very unstable and tends to separate phases during the time. That's the reason why suspensions should be shaken before use (Ph Eur 10).

In previous work, the improvement of the official formulation of *Suspensio album 7.5%* given in *Formulae magistrales 2008 (MF 2008)* was proposed (Savić et al., 2021). This suspension is often compounded in pharmacies since it can be used in the treatment of different skin changes such as acne vulgaris, insect bites, seborrhea, pruritus, etc. Due to its frequent use and having in mind that the stability as well as textural and sensory characteristics are very important for the patients, the improvement of the formulation should be considered.

The purpose of this study was to investigate how further increasing of the concentration of flocculating agent (polysorbate 20) and thickening agent (carbomer gel) can influence the stability and structure of the suspension *Suspensio album 7.5%* (MF 2008) as well as to compare whether the most stable suspension also has the best textural characteristics.

### Materials and methods

#### Materials

In the study following chemicals were used: Zinc oxide (Centrohém), Talc (Fagron), Glycerol, 85%

(Comcen), Carbomer (Fagron), Polysorbate 20 (Comcen) and purified water (Faculty of Medicine, University of Niš).

#### Preparation of the suspensions

Three suspensions were made. First suspension represents modified formulation given in *Formulae magistrales 2008 (MF 2008)* for preparation of *Suspensio album 7.5%* that showed the best characteristics in our previous work (Savić et al., 2021). After grounding of zinc oxide and talc to the appropriate size a homogeneous powder mixture was made in a laboratory porcelain mortar. In the beaker, 1% carbomer gel was prepared. The mixture in the mortar was wetted with glycerol and the obtained paste was then diluted with water, and appropriate amount of polysorbate 20 and carbomer gel were added. Suspension 1 contained 0.1% of polysorbate and 1% of carbomer gel, suspension 2 contained 0.2% of polysorbate and 1% carbomer gel and suspension 3 contained 0.2% of polysorbate and 2% carbomer gel.

#### Sedimentation test

The sedimentation rate of suspended solid substances indicates the physical stability of suspension. The sedimentation coefficient represents the ration of the value of sediment height (mm) and a total height of the suspension after defined time intervals (5 minutes, 30 minutes, 60 minutes, 90 minutes, 120 minutes, and 24 hours).

#### Assessment of stability by centrifugation

The sedimentation coefficient can be determined after 30 minutes of centrifugation (3000 rpm). Using centrifugal force to precipitate heterogeneous suspension is another very popular stability test. The Stokes' law explains the sedimentation of particles, which depends on its size and density.

#### *Texture analysis*

The texture analysis was performed on CT3 Texture Analyzer (Brookfield, AMETEK Inc., USA). Following parameters were set: load cell: 10 kg, test speed: 1.0 mm/s, target value: 1 mm, trigger load: 5 g, cone probe: TA-STF, test type: Texture Profile Analysis (TPA).

TPA test was performed in triplicate. The probe immersed into sample cups (75% of each sample cup was filled with suspension 1, 2 or 3) two times. The following parameters were measured: Hardness cycle 1, Hardness cycle 2, Adhesiveness, Resilience, and Elasticity and were presented as mean values and standard deviations of 3 repeated measurements.

## **Results and discussion**

The results of stability tests have shown that after 30 minutes, all 3 suspensions behaved similarly. The only difference in stability was measured after first 5 minutes, after which the sedimentation coefficient for suspension 1 and 2 stayed above 0.9 and coefficient for suspension 3 fell below 0.9.

The centrifuge test showed that there aren't many differences in suspension coefficient of tested suspensions after centrifuge— suspension 1 (0.35), suspension 2 (0.34) and suspension 3 (0.32).

Textural analysis is useful tool during designing the formulation of the preparations (Gilbert et al., 2013).

The results have shown decrease in Hardness Cycle 2 compared to Hardness Cycle 1, which indicate that the structure weakens after the second compression cycle. This happens probably due to sedimentation of solid particles and natural instability of formulation such as suspension, but since the differences are not big, it means that the weakening of the structure is very small and all suspensions are stable.

The decrease in the Hardness of suspension 3 compared to suspension 1 indicates that this suspension is easier to spread than suspension 1.

All three suspensions show the same value of Adhesion. Therefore, it can be said that they do not differ in stickiness.

Resilience and Elasticity indicate the flexibility of the preparation. While Resilience indicates the energy required to return to the initial position in the case of elastic deformation, Elasticity is an indicator of the height

of the preparation in the sample cup for texture analysis before and after compression (Chandra, 2015). Since both values increased as the concentration of carbomer and polysorbate 80 increased (they were higher considering suspension 2 in relation to suspension 1 and suspension 3 in relation to suspension 2) it can be concluded that the consistency and density of the preparation increased.

Although all changes in texture parameters are quite small, changes in concentrations in formulations 1, 2, and 3 are also small, indicating that they do affect texture analysis results.

While suspensions 1 and 2 have quite similar parameters, there are small differences in stability and texture compared to suspension 3, which are probably the result of increased concentration of thickening agent (carbomer gel). The increase in the concentration of the flocculation agent (polysorbate 20) did not show an effect on the stability and texture properties of the suspensions.

## **Conclusion**

There is a need to constantly consider ways to improve existing formulations compounded in pharmacies, especially those that are used quite often by patients.

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