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Determining Sucrose Concentration in Syrups by Pharmaceutical Methods

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Abstract:

Background:
Pharmaceutics is a basic branch of pharmacy which deals with the formulation and method development. Syrups are basic pharmaceutical preparations that regularly used for the pediatric patients as solid dosage forms are not practical in this population.

Objective:
The main aim of this experiment was to develop a pharmaceutical method for assessing sucrose concentration in syrups by using rheological measures. This will allow forecast of sucrose concentration in the syrup from knowledge of its viscosity.

Methods:
Granulation made of dextrose, starch, 10% gelatin solution, FD&C dye, and magnesium stearate was prepared. The time needed for syrup to pass a bed of the granules placed inside a large pipette tip was recorded in seconds. Syrups viscosity was determined by Ostwald's viscometer, and the specific gravity of the syrup formulations was measured by a pycnometer.

Results:
A non-linear relationship (second-degree polynomial) was observed between the time needed for complete elution of the syrup from the granule bed and the concentration of sucrose in syrup. Likewise, a second degree polynomial relationship was shown to exist between the viscosity of the syrup and its content of sucrose.

Conclusion:
This method can determine with reasonable accuracy the concentration of sucrose in syrups if the viscosity of the test solution was known or if the time for the liquid to pass through a granule bed was measured. This method may also be used for distinguishing non-sugar-based syrups that mimic in their properties the sugar-based formulations.

Keywords: Pharmaceutics; Granulation; Formulation

Introduction:
Syrups are viscous oral liquids that may contain one or more active ingredients in solution. Sucrose is the primary component in syrups. Other substances may be added to syrups for taste enhancement or retarding the crystallization of sucrose [1]. In non-sugar-based syrups, the formulation is primarily made of cellulose type agents with added artificial sweeteners for taste enrichment [2]. For compounding purposes, and as a quality control test for syrups, it is essential to document the amount of sucrose (or lack of) in the final preparation. The addition of sucrose to an aqueous solution renders that solution more viscous [3]. Thus syrups are known to be viscous liquids [4]. The viscosity of a liquid formulation may serve as an indicator for reproducibility among different batches of the product [1]. Added ingredients in syrups may potentially modify the formulation viscosity, and thus influence its mechanical and physical characteristics important for formulation handling [2,5]. Viscosity is the term used to describe the internal friction in a fluid In general, liquids that follow Newton's law of flow are measured by instruments such as capillary viscometers. On the other hand, non-Newtonian systems require more advanced instrumentation to detect the changes in viscosity with increasing the shear rate [5]. For syrup formulations, it is expected that their viscosity to follow a Newtonian flow [6]. Current methods available for the determination of sucrose are cumbersome and require complex procedures and instrumentation. This study proposes the use of simple rheological measurements for the quick determination of sucrose in aqueous solutions. More specifically, we aim to develop a rheological method by which the concentration of sucrose in an aqueous liquid can be estimated from knowledge of its Newtonian viscosity. Furthermore, this method will also be used to correlate the concentration of sucrose in syrup to the time needed for the syrup to descend through a bed of granulation.

Discussion:
The results showed that the time for the syrup solution to pass through the granule bed increased as the concentration of the sucrose increased in the syrup (Table 1). As expected, the viscosity of the syrup also increased with increasing concentration of sucrose in solution (Table 4) [3,4]. An empirical relationship (equation 2) was found between the time for the syrup to pass through the granules and the concentration of sucrose in solution ($R^2=0.9467$; $p=0.0028$). Likewise, the sucrose concentration in syrups can be estimated from equation (4), relating sucrose concentration (% w/v) to the viscosity of the syrup expressed in centipoises ($R^2=0.9883$; $p<0.0001$). Also, another empirical relationship (equation 3) was found between the viscosity of the syrup and the time for the test solution to travel through the granule bed ($R^2=0.9196$; $p=0.0065$). From the experimental findings, it is possible for an unknown solution of sucrose to be determined by either measuring the viscosity of that solution or by determining the time needed for it to pass through a column filled with granules. In either case, the predicted value of the concentration of sucrose in solution would be determined with high accuracy due to the high correlation associated with both empirical equations. The study [7] proposed enzymatic methods/HPLC while

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other study [8] used a spectrophotometric method for the determination of sucrose in samples. Older methods for sucrose determination rely on refractometry or density measurements. The implications of this study are that compounding pharmacists or formulators in general will be able to check the concentration of sucrose in the final product by using a quick and simple capillary viscometer measurement. This is a more practical way for sucrose determination as the other methods require more complex procedures and instrumentation. As for its limitations, although this method may become attractive due to its simplicity, its sensitivity and specificity may not be as high as the other analytical methods.

Conclusion:

In this study, a rheological method was developed by which the concentration of sucrose in syrups can be determined with reasonable accuracy if the viscosity of the test solution was known or if the time for the liquid to pass through a granule bed was measured. More research is needed to check for the reproducibility and effectiveness of this pharmaceutical technique.

Conflicts of Interest

The authors declare no conflicts of interests.

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