Starch as Drug Carrier

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***Abstract*— In recent years, the pharmaceutical industry has seen a shift towards a greater emphasis on biologics as drugs. The study has carried out to determine the criteria to produce a great drug carrier. This study involves the investigation of different amount of drugs towards its solubility that can be related to efficiency. Tests that are conducted are on the effect different pH solution on the solubility of the drug, Starch gel-like substance was being produced as the drug carrier. Based on the tests carried out, the suitability of starch as drug carrier is determined. These Experiment is divided into three parts which are the test on different amount of drug, different type of pH and producing the drug carrier using starch. The product were analyst by observation method and the results will be recorded thus justification will be made. The results obtained from the experiment can summarized as follow. The increasing of amount of drug increased the solubility, the increasing of pH number decreased the time for drug to settle down and starch can be concluded suitable to use as drug carrier. The objectives of the study were successfully achieved..**

***Keywords*:**
Drug Carrier
Starch
Pharmaceutical
Medicine

I. INTRODUCTION

The challenge of developing oral delivery for therapeutic molecules lacking optimal properties has stimulated much research in the pharmaceutical industry. Common problems that are continually faced in developing oral dosage forms of active pharmaceutical ingredients include very low aqueous solubility, high polarity or high molecular weight, resulting in a lack of permeability, and degradation due to high acidity or enzymatic activity.

Over the years, chemists and pharmaceutical scientists have been able to massage some formulations to overcome these issues to develop oral products. On the other hand, many molecules have been limited to dosing or, in some cases, shelved because they did not have the 'druglike' properties to be orally absorbed.

Various techniques for fabricating core-shell micro particles have been reported. Multiple emulsions, which allow the discontinuous phase of the primary emulsion to encapsulate and form the core, are facile manufactured through two-step bulk emulsification. The limitations of the technology are that the core and shell material must be immiscible, and the architecture and size distribution are not easy to be well controlled (L. Caprreto et. al, 2012).

In recent years, the pharmaceutical industry has seen a shift towards a greater emphasis on biologics as drugs. The study has carried out to determine the criteria to produce a great drug carrier. Some characteristic of drug carrier were to be determined which are this study involves the investigation of different amount of drugs towards its solubility that can be related to efficiency, tests that are conducted are on the effect different pH solution on the solubility of the drug, starch gel-like substance was being produced as the drug carrier, based on the tests carried out, the suitability of starch as drug carrier is determined.

II. METHODOLOGY

A. Materials

The materials used are distilled water, Metformin 500 mg brand ccm, and Fruit Bean Curd Pudding Powder that contains 30% of carbohydrate (starch)

B. *Chemicals*

Chemicals used are 2M of Hydrochloric Acid and Potassium Hydroxide.

C. *Apparatus/Instruments*

List of apparatus used are heater, Weighing machine, 500mL beaker, Spatula, 50mL Conical flask, Stone mortar, pH meter and Incubator.

D. *Preparation of sample*

The metformin tablet is being crush into small pieces and then continued being crush until it turn to powder forms using stone mortar. Next, the powder is being scoop using spatula and weight in weighting machine into different amount of powder needed. The drug is ready for further experiment use.

E. *Experimental Procedure*

These Experiment is divided into three parts which are the test on different amount of drug, different type of pH and producing the drug carrier using starch. For the first experiment, the difference amount of drug was being test its solubility by mixing it with a fixed amount of distilled water. Initially, 50 ml conical flask was being filled with distilled water. Then, 0.5g of metformin was being put into the conical flask. Shake the conical flask for 10 shakes. After that, initially and after 10 minutes. Repeat the steps by using different mass of powder.

For the second experiment, the different amount of pH solution was initially prepared. The pH solution prepared was from pH 1 Solution until pH 14 solution. Different number of pH solution was prepared by mixing distilled water with either hydrochloric acid or potassium hydroxide to manipulate the number of pH. The number of pH was being checked by using pH meter. After that, insert 50 ml of each pH solution into different conical flask. Then, 0.5g of metformin was being put into the conical flask. After that, observe the reaction of powder initially and after 10 minutes. Repeat the steps by using different pH solution.

For the third experiment, the starch as drug carrier was initially prepared. The starch was prepared by making it to gel-like substances using starch. The solution was prepared by fill 200 mL distilled water in the beaker and boil it. After the water is boil, mix 24g of powder and stir for 15 minutes. After that, put 1g of metformin into the solution. Observe the powder in the solution. Transfer it to other beaker to see if there is insoluble of metformin.

Put the solution in incubator which is set to 4.0℃ for 1 day, so that the solution will turn to gel-like substances. After a day, cut the gel-like substance into small pieces and observe the sign of powder in the gel.

E. *Analysis*

The product were analyst by observation method. The observation method focused on the physical properties. The observation will be made by observing the time to settle down and solubility of powder in solution. The results will be recorded and the justification will be made

III. RESULTS AND DISCUSSION

A. The observation Of Different in Mass of Drug Powder

The result of the observation for each mass were tabulated in Table 1 below.

Mass Drug Powder	Time of the powder to settle down
0.50g	0s
0.75g	9s
1.00g	33s
1.25g	38s
1.50g	41s

Table 1: The Observation On Different In Mass Of Drug Powder.

Based on the result, it was shown that lower mass of powder which is 0.5g, 0.75g, 1.0g and 1.25g has shorter time to settle down which are 0s, 9s, 33s and 38s respectively. The trend of the reaction is the higher the mass of powder, the longer the time it takes to settle down. The time for powder to settle down need to be longer because the drug should be move slowly into the body so that the drug can transfer it nutrient into demanding part of the body and its usually in the stomach.

It was improved that the time for powder to settle down was increased due to increasing the mass of the powder. This is due to particles absorbing water just following the wetting stage and this swelling process leads to the increase in particle size at the first stage of dispersion (Gaiani et al., 2006).

Wetting process can be described as: firstly, the interface of solid and gas is replaced by the interface of solid and water; secondly, inward diffusion of the liquid through the capillary structures of the porous powder particle (Yuan & Lee, 2013).

It can be proven by the previous study by Lazghab et al., (2005), which stated that agglomerated powders usually have better wettability than standard powders, as liquid is more easily able to permeate between the powder particles and wet them more quickly.

The graph of time for powder to settle down versus mass of powder was plotted in the Figure 1 based on the result from Table 1. The trend of the graph obtained in this study was as same as the trend of the graph conducted by Junfu et al., (2016).

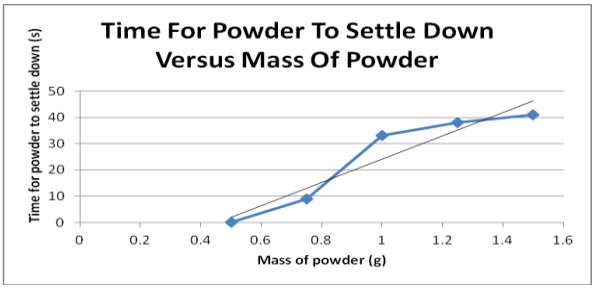

Figure 1: Graph Of Time For Powder To Settle Down Versus Mass Of Powder.

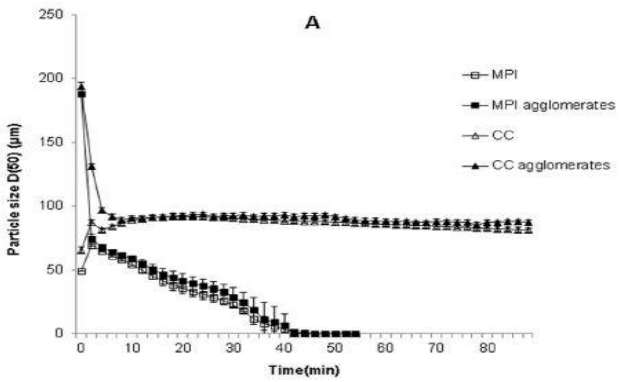

Figure 2: Graph of Particle Size Versus Time For Settle Down (Junfu et al., 2016)

B. *The Observation Of Different in pH solution*

The Observation Of Different in pH solution were tabulated in Table 2. The solution were prepare from various pH 1 solution to pH 14. The powder is then mix in each pH solution and observation has been made on the changes of the powder.

pH Number	Initial Observation	Final Observation
1	The powder dissolve slowly	The powder dissolve completely
2	The powder dissolve slowly	The powder dissolve completely
3	The powder dissolve slowly	The powder dissolve completely
4	The powder dissolve slowly	The powder dissolve completely
5	The powder dissolve slowly	The powder dissolve completely
6	The powder dissolve faster than pH 1- pH 5	The powder is partially dissolve
7	The powder dissolve faster than pH 1- pH 6	The powder is partially dissolve
8	The powder dissolve slowly	The powder is less dissolve than pH 1-pH 7
9	The powder dissolve slowly	The powder is partially dissolve
10	The powder dissolve slowly	The powder is partially dissolve
11	The powder dissolve slowly	The powder is the least dissolve compare to other pH
12	The powder dissolve fastest	The powder dissolve completely
13	The powder dissolve slower than pH 12	The powder dissolve completely
14	The powder dissolve slower than pH 12-pH13	The powder is coagulate at top

Table 2: The Observation Of Different in pH solution

Based on the result, it was shown that at very acidic solution, the initial reaction of the powder that was mix with the solution is same for pH 1, pH 2, pH 3, pH 4, pH 5 which is dissolve slowly. But, when the solution is at pH 6, the powder is dissolve faster than pH 1 to pH 5. Eventually, at neutral solution the powder is dissolved faster than acidic solution.

Meanwhile, the initial observation for the alkaline solution is the powder dissolve slowly at pH 8, pH9, pH 10 and pH 11 solution. The fastest time for the powder to dissolve was at pH 12 solution. Even the solution is more alkaline which is pH 13 and pH 14, the powder dissolve slowly than pH 12.

It was noted that the solubility is increased due to the increasing of pH number. The solubility of a weak acid or base is often pH

dependent. The total quantity of a monoprotic weak acid (HA) in solution at a specific pH is the sum of the concentrations of both the free acid and salt (A-) forms. If excess drug is present, the quantity of free acid in solution is maximized and constant because of its saturation solubility. As the pH of the solution increases, the quantity of drug in solution increases because the water-soluble ionizable salt is formed (Allen et al., n.d.).

This statement can be supported by referring to statement by Lee et al., (2013), their experimental results showed that all three amino acids exhibit an increase in solubility as the pH of the solutions move away from the isoelectric point.

Besides, the result obtained may also be supported by using the theory that the solubility does not directly proportional to the increasing of pH number dependently. There may be a certain pH level reached where the total solubility of the drug solution is saturated with respect to both the salt and acid forms of the drug. This would be due to the fact that the solution can be saturated with respect to the salt at pH values higher than this, but not with respect to the acid. Also, at pH values less than this, the solution can be saturated with respect to the acid but not to the salt (Allen et al., n.d.).

The illustration of solubility with the effect of pH was plotted in Figure 4.3 based on summarization the information from Table 4.3. By referring to the graphs made by (Allen et al., n.d.) the trend obtained from this study were nearly same as theirs.

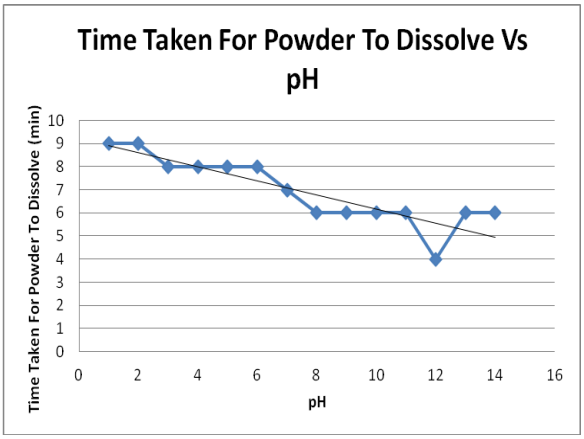

Figure 3: Graph of Time Taken For Powder To Dissolve Versus pH

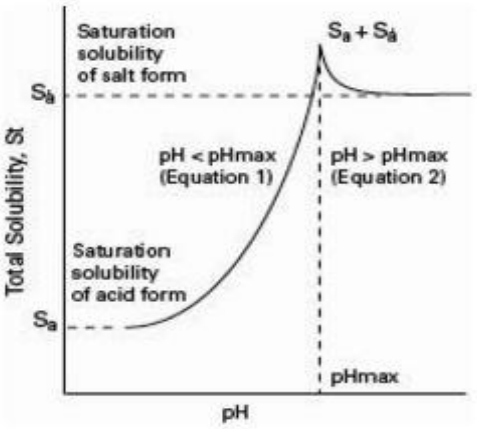

Figure 4: Graph of Total Solubility Versus pH (Allen et al., n.d.)

C. *The Effect of Starch as Drug Carrier*

The observation been made on the drug carrier that was used to carry the powder is starch was tabulated in Table 3

Type of Drug Carrier	Initial Observation	Final Observation
Starch	The powder dissolve completely into the solution	The powder cannot be seen in the small pieces of gel-like starch

. **Table 3:** The Effect of Starch as Drug Carrier

Based on the observation, initially the powder was dissolve completely at the solution before the solution was turn to gel-like phase. No sign of powder in the solution. Figure 5 shows that no sign of powder in the solution. After the solution is being cooled and it turns to gel-like phase, another observation have been made. The powder cannot be seen in the gel-like starch phase Even after, the starch is cut into small pieces there is no sign of drug powder. Figure 6 will show that no sign of drug powder after the starch is being cut into smaller pieces.

It was found that some compound had been use as drug courier which is gelatin. As a drug delivery carrier, gelatin has proven to be versatile due to its intrinsic features that enable the loading of charged biomolecules. Indeed, by selecting either alkaline or acidic treatment, the gelatin isoelectric point (IEP) can be tailored to maximize drug loading efficiency depending on the electrostatic properties of the desired drug molecule (Tabata, 1998)

Based on the finding of Santoro et al (2014), gelatin has been successfully incorporated in numerous composite materials, particularly in musculoskeletal tissue engineering. The synergistic use of gelatin with other biomaterials enables higher flexibility in terms of material degradation and controlled release, while maintaining and enhancing the properties of the bulk material. So, we can consider to uses of other material such as starch as the drug carrier.

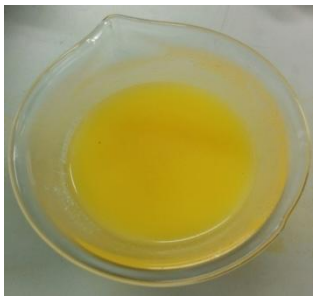

Figure 5: No Sign Of Powder In The Solution

Figure 6: No Sign Of Drug Powder After The Starch Is Being Cut Into Smaller Pieces

The effect of difference amount of drug on its solubility have been determined. Besides, the effects of drugs with different type pH solution were obtained. Lastly, the suitability of starch as a drug carrier have been identified.

Some recommendations were generate for future study on the same or similar thesis topic. Recommendations are expected to improve the future work. The study many be more applicable and

better if following suggestion are done. It is suggested to investigate the wettability of the drug powder. Wettability is more related to the solubility of a powder.The solubility of drug powder in water at various pH values can be measured using a colorimetric method. The data will be more accurate and can be correlated using the chemical model and the NRTL model. Study about the characteristic of the starch such as size, morphological and surface charge using various equipments which are spectrophotometer, photon correlation spectrometry, Lazer Zee meter and Scanning Electron Microscopy.

IV. Conclusion

As for the conclusion, the effect of difference amount of drug on its solubility have been determined. Besides, the effects of drugs with different type pH solution were obtained. Lastly, the suitability of starch as a drug carrier have been identified. The objectives of the study were successfully achieved. The results obtained from the experiment can summarized as follow. The increasing of amount of drug increased the solubility. The increasing of pH number decreased the time for drug to settle down .Lastly, Starch is suitable to use as drug carrier.

Acknowledgment

Thank you to my supervisor and Universiti Teknologi Mara..

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