Apr 12th, 6:45 PM - 7:30 PM

Floating Drugs: A Roundtable

Thien Nguyen
Health Science Academy

Noelia Valle
Health Science Academy

Floating Drug Delivery System in the Stomach

Thien Nguyen, Noelia Valle, and Anne McIntryre

Collin College

Abstract

This paper will discuss how the stomach plays a role in the floating drug delivery system. This particular drug delivery system consists of a capsule that floats on the gastric acids in the stomach. The drug inside the capsule is slowly released based on the rate of which the system desires. The stomach then will allow the system to flow out. This will then result in an increased gastric retention time and improved drug absorption, which allows the drug to be most effective. In addition, this drug delivery system can be beneficial in that it can treat many disorders like gastric reflux. The performance of this delivery system can be influenced by how controlled it is and how easy the administration of this system is. The growth of technology in drug delivery has allowed for process like the drug delivery system to be widely effective for anyone.

Keywords: [floating, drug, delivery, system, stomach, gastric, retention, effective]

Proposal

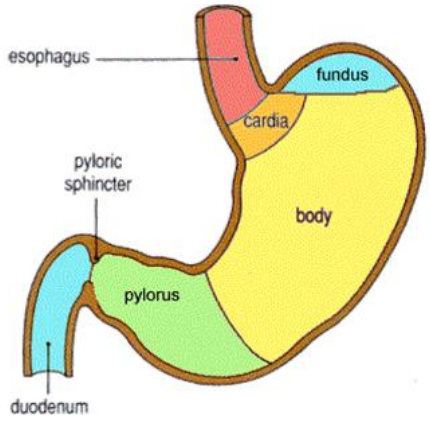
Our research project will be on the stomach. We will specifically discuss the floating drug delivery system and how it can be an effective way to deliver medicine. This particular delivery system is a new approach of to treat diseases like cardiovascular disease and stomach reflux.

As a group, we will present our research with an essay, a poster board, and a model. The essay will be about twenty pages that consist of mainly our research, but contain our abstract and annotated bibliography. The poster board will contain graphs and data from what we have researched. Finally, the model will attempt to demonstrate how the system is able to float on gastric acid in the stomach and then disperse the drug.

The roles will be divided in two. Thien will be doing most of the research about this particular drug delivery system. In addition, he will be contacting the mentor and making sure that he/she will be cooperating and that he/she is able to meet up when needed. On the other hand, Noelia will be in charge of the poster and its design and organization. She will also be researching as well. After the essay and poster are done, we will both work on the 3-D model that will demonstrate this system.

Floating Drug Delivery System in the Stomach

The floating drug delivery system is a drug treatment that takes place in the stomach and gastrointestinal tract. The anatomy of the stomach can be divided into three parts. The fundus makes the top portion of the stomach, and the body and pylorus follows. The fundus and body has the responsibility of storing any excess undigested material. While the pylorus has the responsibility of making sure no intestinal contents are reentered into the stomach and that everything is processed properly before material can move in to the intestines. The process of gastric emptying occurs when the stomach is fed as well as when the stomach is fasting. During the fasting state, the stomach goes through a series of electrical mechanisms called the migrating myloelectric cycle. The first phase, basal phase, infrequently has contractions and can last up to sixty minutes. The second phase, preburst phase, there are recurring contractions as the intensity increases as well. The third phase, burst phase is when there are intense contractions for the reason that undigested material are released from the stomach into the intestines. When food is ingested, that is when the fasting stage is changed to the fed state, in which there are rapid contractions to allow the material to be broken down into pieces.



There are two types of systems when it comes to the design of the floating drug delivery system: the effervescent and non-effervescent system. These two approaches give the drug delivery system different ways to deliver the desired drug for the patient. In the category of effervescent systems, the use of gas agents and organic acids are utilized to create carbon dioxide allow the system to float because of the reduced density. Effervescent systems can be divided into two types: gas-generating and volatile liquid or vacuum systems. The intra gastric single layer floating tablets are an example of the gas-generating system. In the gas-generating system carbon dioxide agents are fused with the drug within the matrix tablet which then allows the bulk density to be less than that of gastric acid. The system is able to float on the gastric fluid and then thee drug contents are slowly released at the preferable rate designed by the system. The design of the gas-generating system can be seen in Figure 2.

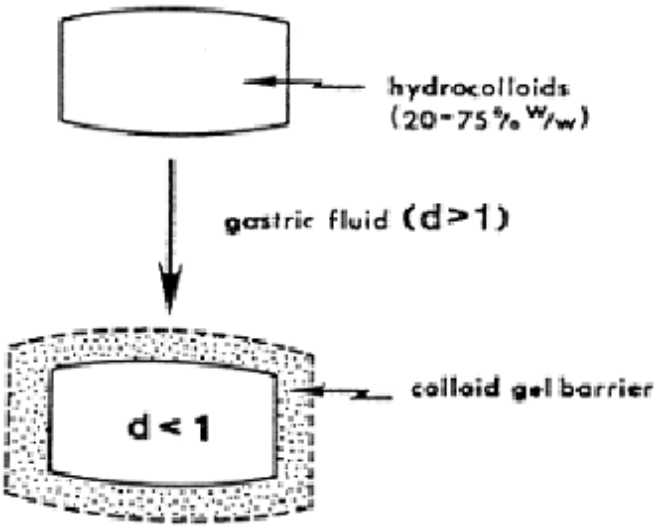


Figure 2: intra gastric single layer floating tablet

The intra gastric bi-layer floating tablet is similar to the intra gastric single layer except for the fact that this one has a design that consists of two layers: an immediate release layer and a sustained release layer.

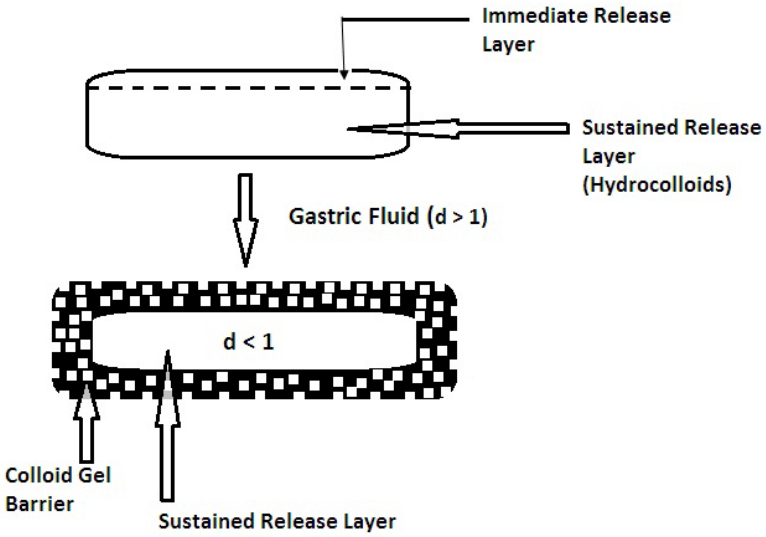


Figure 3: Intra gastric bi-layer floating tablet

Furthermore, there is also the multiple-unit dosage system which has a sustained release pill surrounded by an effervescent layer and an outer swell able layer. This system will sink once released into a dissolving, but swollen pills will grow in a shape similar to balloons that allow the system to gradually float because of the reduced density from the creation of carbon dioxide inside the system.

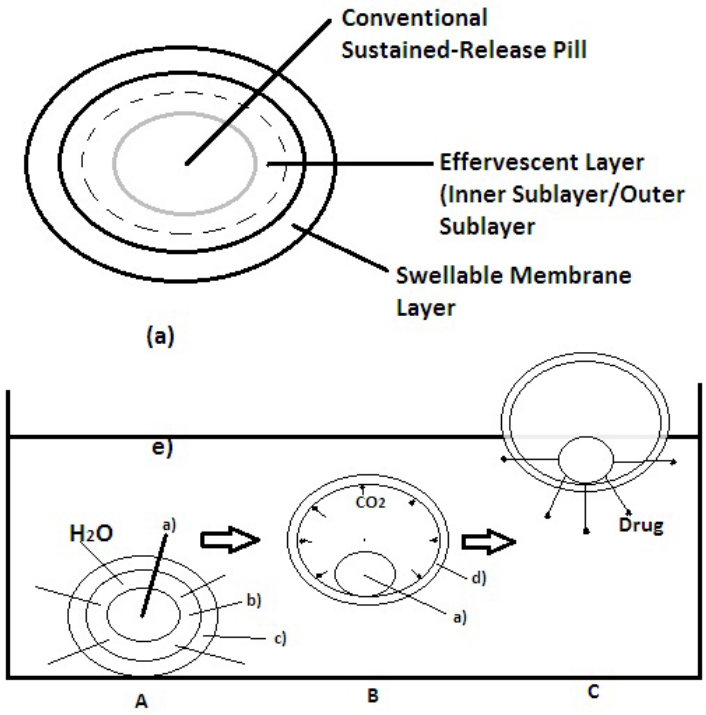


Figure 4: multiple-unit dosage system

The volatile liquid or vacuum containing system is another type of the effervescent system. An example of this system is the intra-gastric floating gastrointestinal drug delivery system, which has floatation ability due to the floatation chamber filled with a gas. The drug in this system is stored in a wall characterized by small pores. Figure 5 will give a representation of this system.

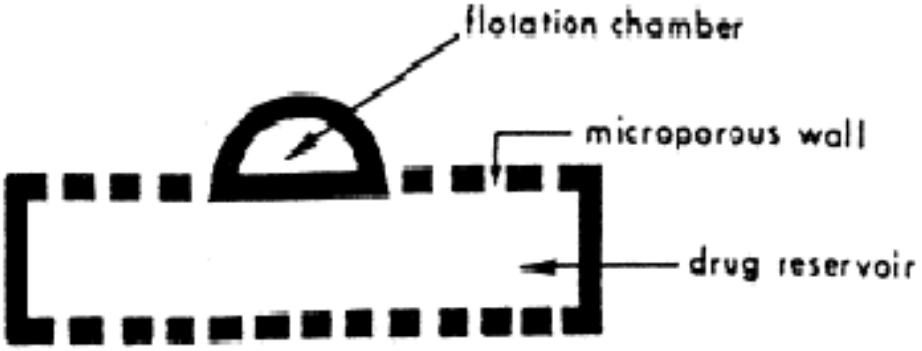


Figure 5: Intra-gastric floating gastrointestinal drug delivery system

Another example of the volatile liquid system is the inflatable gastrointestinal delivery system. The main concept of this system is its inflatable chamber that is filled with liquid esther which will allow the chamber to inflate when desired. Along with the liquid ether, the drug reservoir that stores the drug is incorporated into the inflatable chamber. All of this is surrounded by a special gelatin capsule. Once the capsule is in the stomach, it will dissolve and the inflatable chamber and drug reservoir will be released onto the gastric acid.

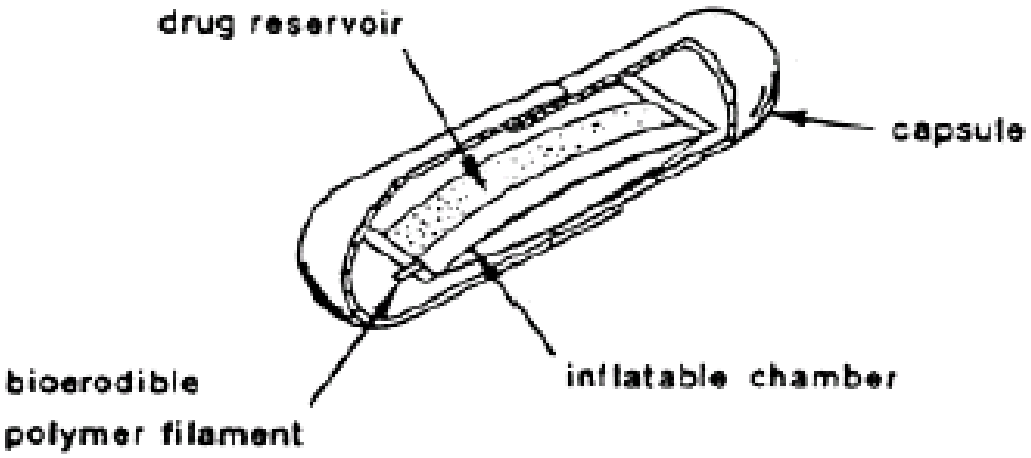


Figure 6: Inflatable gastrointestinal delivery system

The last example of the volatile liquid system is the intragastric osmotically controlled drug delivery system. This system is controlled by an osmotic pressure device as well as an inflatable floating support that is located in a capsule. Once this capsule is dissolved by the gastric acid, the osmotic system is released. The inflatable support will then form a polymeric bag that contains a liquid that will trigger the response for the bag to inflate. The osmotic pressure controlled drug delivery device can be comprised of two portions: osmotically active and drug reservoir compartment. The drug reservoir is surrounded by a pressure responsive bag which is resistant to vapors and liquid. Meanwhile, the osmotically active compartment

contains a specialized salt and is surrounded by a semi-permeable membrane. The water in the gastrointestinal fluid will then be absorbed by the semi-permeable membrane into the osmotically active compartment and the salts will disintegrate. After all of this, an osmotic pressure will then trigger the drug reservoir to decrease its volume and release the desired drug solution. After a while, the floating support will degrade and the system will be released from the stomach. Figure 7 will show the detailed structure of the intragastric osmotically controlled drug delivery system.

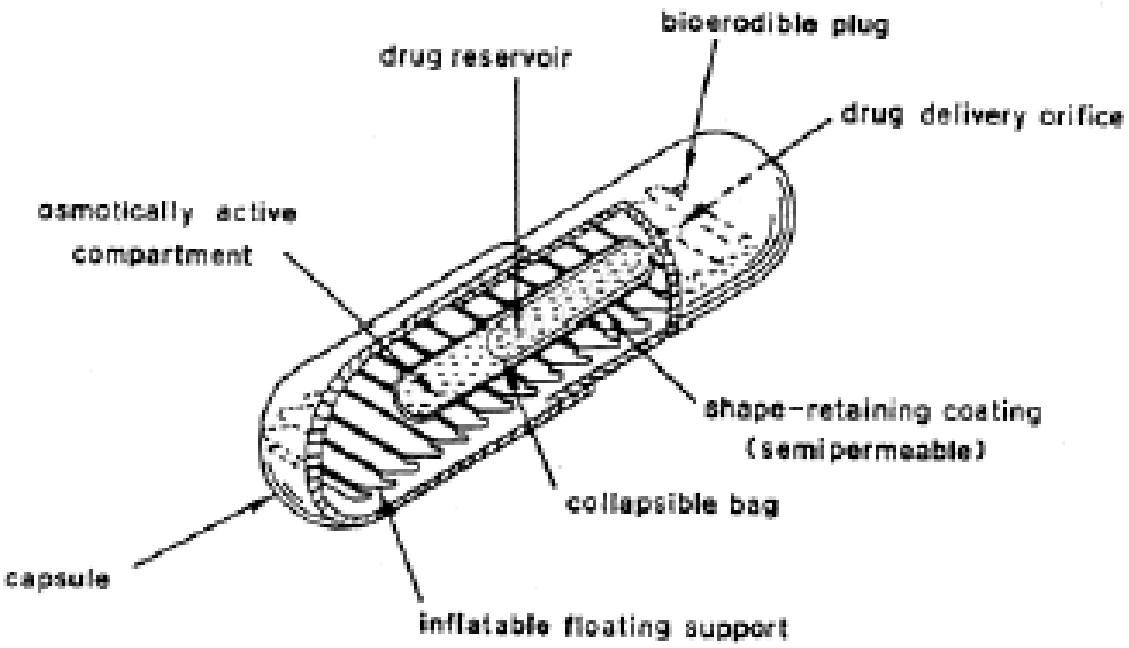
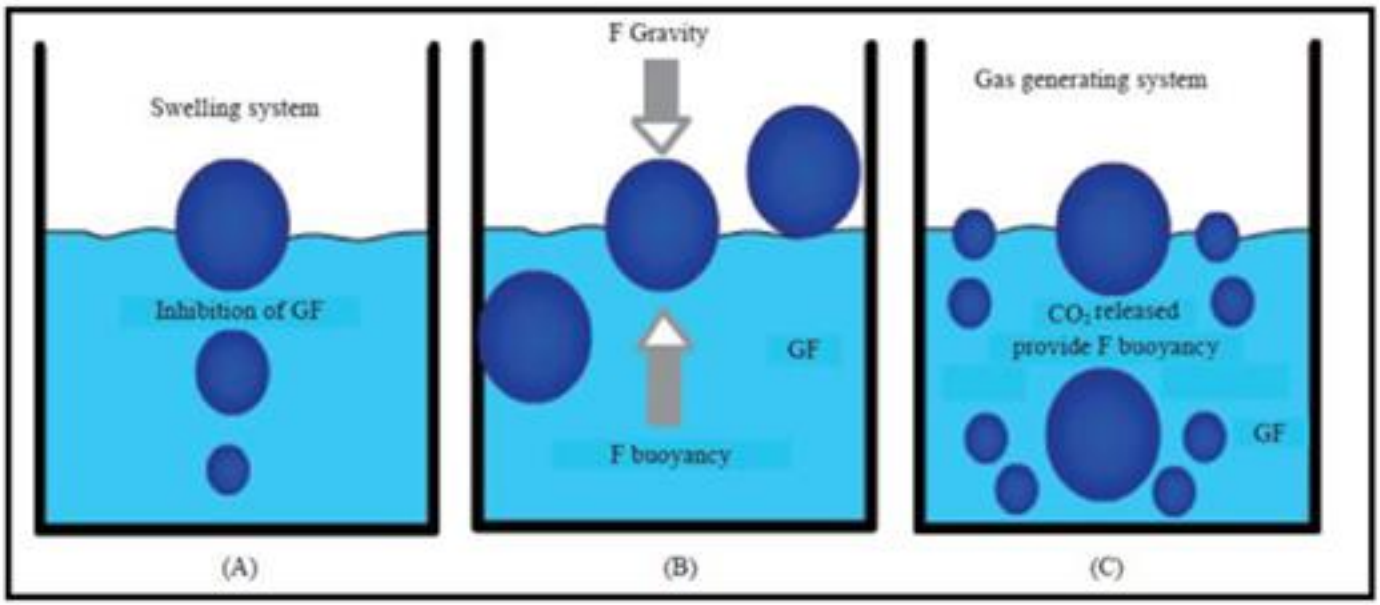


Figure 7: Intragastric osmotically controlled drug delivery system

The mechanism of this floating drug delivery system consists of a system that obtains a density less than that of the gastric fluid in the stomach. The system is able to float on the gastric fluid and then thee drug contents are slowly released at the preferable rate designed by the

system. Following the release of the drug, the system will disintegrate and then removed from the stomach.

With this system, comes a plethora of advantages that allows it to be an effective way of drug delivery. This drug delivery system can increase the time that a drug is absorbed in the stomach. This is due to the increased gastric retention time in which the substance is able to float at its absorption location. It can also reduce the likelihood of mucosal irritation that is can usually be caused by drugs. This is for the reason that the drug is released at a steady pace rather than a rapid delivery of the drug.



References

Arora, S., Ali, J., Ahuja, A., Khar, R., & Baboota, S. (2005). Floating drug delivery systems: A review. *AAPS PharmSciTech,* 372-386. Retrieved February 17, 2017.

Avinash, K., Abha, D., Praween, K., & Abhinav, G. (2012). Floating drug delivery system a significant tool for stomach specific release of cardiovascular drugs. *International Journal of Drug Development and Research,* 116-129. Retrieved February 17, 2017.

Bhardwaj, V., & Harikumar, N. (2013). Floating drug delivery system: A review. *Pharmacophore,4*(1), 26-38. Retrieved February 17, 2017.

Dixit, N. (2011). Floating drug delivery system. *Journal of current pharmaceutical research*, *7*(1), 6-20.

Gupta, P., Kothiyal, P., & Kothiyal, G. (2015). Floating drug delivery system: A review. *International Journal of Pharma Research & Review*, 37-44. Retrieved February 17.

Kaur, B., Sharma, S., Sharma, G., Saini, R., Singh, S., Nagpal, M., . . . Sharma, M. (2013). A review of floating drug delivery system. *Asian Journal of Biomedical and Pharmaceutical Sciences*, *3*(24), 1-6. Retrieved February 17, 2017.

Narang, N. (2011). An updated review on: Floating drug delivery system. *International Journal of Applied Pharmaceutics,3*(1), 1-5. Retrieved February 17, 2017.

Sharma, N., Agarwal, D., Gupta, M. K., & Khinchi, M. (2011). A comprehensive review on floating drug delivery system. *International Journal of Research in Pharmaceutical and Biomedical Sciences*, *2*(2), 428-441.

ST, P., LD, P.,& CN, P. (2010). Polymers for floating drug delivery system. *Systematic Reviews in Pharmacy,* 1-7. Retrieved February 17, 2017.

Vidyanagar, V. (2008). Floating drug delivery systems to increase gastric retention of drugs: A review . *Research Journal of Pharmacy and Technology*. Retrieved February 17, 2017.

Annotated Bibliography

Arora, S., Ali, J., Ahuja, A., Khar, R., & Baboota, S. (2005). Floating drug delivery systems: A review. *AAPS PharmSciTech*, 372-386. Retrieved February 17, 2017.

This article is written by Shweta Arora, Javed Ali, Alka Ahuja, Roop K. Khar, and Sanjula Baboota. They are given authority from the Department of Pharmaceutics at Hamdard University. This source relates to our research topic because it provides visual diagrams about the floating delivery system. This article supports our thesis and helps give us a visual about what is going on with this system.

Avinash, K., Abha, D., Praween, K., & Abhinav, G. (2012). Floating drug delivery system a significant tool for stomach specific release of cardiovascular drugs. *International Journal of Drug Development and Research*, 116-129. Retrieved February 17, 2017.

This source is authored by Kaushik Avinash, Dwivedi Abha, Kothari Praween, Govil Abhinav. The authors receive authority from the School of Pharmaceutical Sciences at Jaipur National University. The article relates to our research because it discusses the advantages that comes with the usage of the floating drug delivery system. This article supports our thesis and benefits our research.

Bhardwaj, V., & Harikumar, N. (2013). Floating drug delivery system: A review. *Pharmacophore*,4(1), 26-38. Retrieved February 17, 2017.

This articles is written by Vishal Bhardwaj and NirmalaHarikumar. They receive their authority from the Rayat and Bahra Institute of Pharmacy. This article relates to our research as it provides statistics on the science behind the system's density levels that allows it to float on the gastric acid in the stomach. This article supports and aids our research.

Dixit, N. (2011). Floating drug delivery system. *Journal of current pharmaceutical research*, *7*(1), 6-20.

This article is authored by Nikita Dixit and the author received his or her authority from the Nagaji Institute of Pharmaceutical Sciences. This relates to our research because it provides a lot of mathematical statistics about how the floating system works. Therefore, this article will support our thesis and research.

Gupta, P., Kothiyal, P., & Kothiyal, G. (2015). Floating drug delivery system: A review. *International Journal of Pharma Research & Review*, 37-44. Retrieved February 17.

The authors of this article are Pooja Gupta, Gnanarajan, and Preeti Kothiyal. They are given authority from the Department of Pharmaceutics, Shri Guru Ram Rai Institute of Technology & Sciences. The information provided by the article allows us to better understand the principal mechanism of floatation in this delivery system to achieve gastric retention. The article supports our thesis and benefits our research.

Kaur, B., Sharma, S., Sharma, G., Saini, R., Singh, S., Nagpal, M., . . . Sharma, M. (2013). A review of floating drug delivery system. *Asian Journal of Biomedical and Pharmaceutical Sciences*, 3(24), 1-6. Retrieved February 17, 2017.

The authors are given authority from the Pharmaceutics division, Chandigarh College of Pharmacy, Landran, Mohali, and they are Bhavjit Kaur, Shivani Sharma, Geetika Sharma, Rupinder Saini, Sukhdev Singh, Meenu Nagpal, Upendra K Jain, and Mandeep Sharma. The information provided by this article relates to our research by the improvement in increasing the gastric residence time and controlling the drug release in the Floating Drug Delivery System. This information not only supports our thesis but it benefits our research and allows to better understand the information.

Narang, N. (2011). An updated review on: Floating drug delivery system.*International Journal of Applied Pharmaceutics*,3(1), 1-5. Retrieved February 17, 2017.

The author of this article is Neha Narang. The author is given authority by the Shri Baba Mastnath Institute of Pharmaceutical Sciences and Research. This article relates to our research because it provides information on the current drug used today that contain the chemistry of the floating drug delivery system. This source will help support our thesis.

Sharma, N., Agarwal, D., Gupta, M. K., & Khinchi, M. (2011). A comprehensive review on floating drug delivery system. *International Journal of Research in Pharmaceutical and Biomedical Sciences*, *2*(2), 428-441.

The author of this article is Natasha Sharma. They received their authority from the College of Pharmacy in India. The article relates to our research because it discusses the anatomy of the stomach and GI tract it helps us better understand the floating delivery system. This source will definitely support our thesis.

ST, P., LD, P.,& CN, P. (2010). Polymers for floating drug delivery system. *Systematic Reviews in Pharmacy*, 1-7. Retrieved February 17, 2017.

The authors of this article are Prajapati ST, Patel LD, and Patel CN. They have authority to this article due to their credentials they have received at the Department of Pharmaceutics and Pharmaceutical Technology, Shri Sarvajanik Pharmacy College, Mehsana, Department of Pharmaceutics and Pharmaceutical Technology, and C. U. Shah College of Pharmacy, Wadhvan, Gujarat, India. The information provided by the article allows us to better understand the additional advantages for the Floating Drug Delivery System in the upper segments of the gastrointestinal tract. This article supports our thesis and benefits our additional research.

Vidyanagar, V. (2008). Floating drug delivery systems to increase gastric retention of drugs: a review . *Research Journal of Pharmacy and Technology*. Retrieved February 17, 2017.

This article is written by Vallabh Vidyanagar. The authority from the AR College of Pharmacy and GH Patel Institute of Pharmacy. This article can relate to our topic because it provides multiple approaches to this delivery system including the single-unit dosage form and the multiple-unit dosage form. This article will support our thesis so that it can provide us with a variety of information.

Consent Form

ST MACH

I Thien Nguyen, give permission for Noelia Valle and our student mentor, Anne McIntyre, to utilize the information from our Undergraduate Research Health Sciences Symposium (URHSS) workshop project for educational purposes only. These individuals have the permission to utilize this scholarly material as long as they provide the proper attribution to all the parties involved.

Signatures:

Noelia Valle
Date: 2/10/17

Thien Nguyen

Date: 2/10/17

Anne McIntyre
Date: 2/10/17