



# DEFECTS OF TABLET MANUFACTURING PROCESS- AN OVERVIEW

1. Ms. Sakshi Sahebrao Ade, (Student), Vardhaman College of Pharmacy, Koli, Karanja (Lad)
2. Mr. Vaibhav Prameshwar Paturkar, (Student), Vardhaman College of Pharmacy, Koli, Karanja (Lad)
3. Dr. Neha N. Rajpurohit, (Assistant Professor), Vardhaman College of Pharmacy, Koli, Karanja (Lad)
4. Dr. K Raja Rajeshwari, (Principal), Vardhaman College of Pharmacy, Koli, Karanja (Lad)

## **ABSTRACT**

Although there are various causes of tablet problems, many are simply preventable. Technicians engaged in tableting need to be completely knowledgeable about the procedure and the materials in order to solve flaws. To ensure that a technician has the abilities needed to service equipment and reduce production issues, they must receive enough training in machine setup and operation. While a rookie or inexperienced operator cannot and may even be frightened to make adjustments to the machine in order to prevent or correct problems, a competent and experienced technician may transform an ordinary product into a high quality one. Tablet manufacture will run smoothly when the machinery is run correctly. It is unacceptable to have tablet flaws or manufacturing flaws in tablets. However, frequently, tablet flaws make tablet creators or formulators ashamed to create a new tablet. This page describes several fixes for different tablet flaws. We provide images to explain different tablet problems. If you work in formulation research and development, as an industrial pharmacist, or in product development, you need to be aware of these tablet faults and their fixes.

## **INTRODUCTION**

Solid drugs that are frequently administered orally in the form of tablets, capsules, powders, cachets, or capsules. Since they include a quantity of medication that is delivered as a single unit, these dosage forms even in the case of prolonged action preparations are collectively referred to as solid unit dosage forms. Those are equivalent to several typical pharmaceutical dosages in theory.

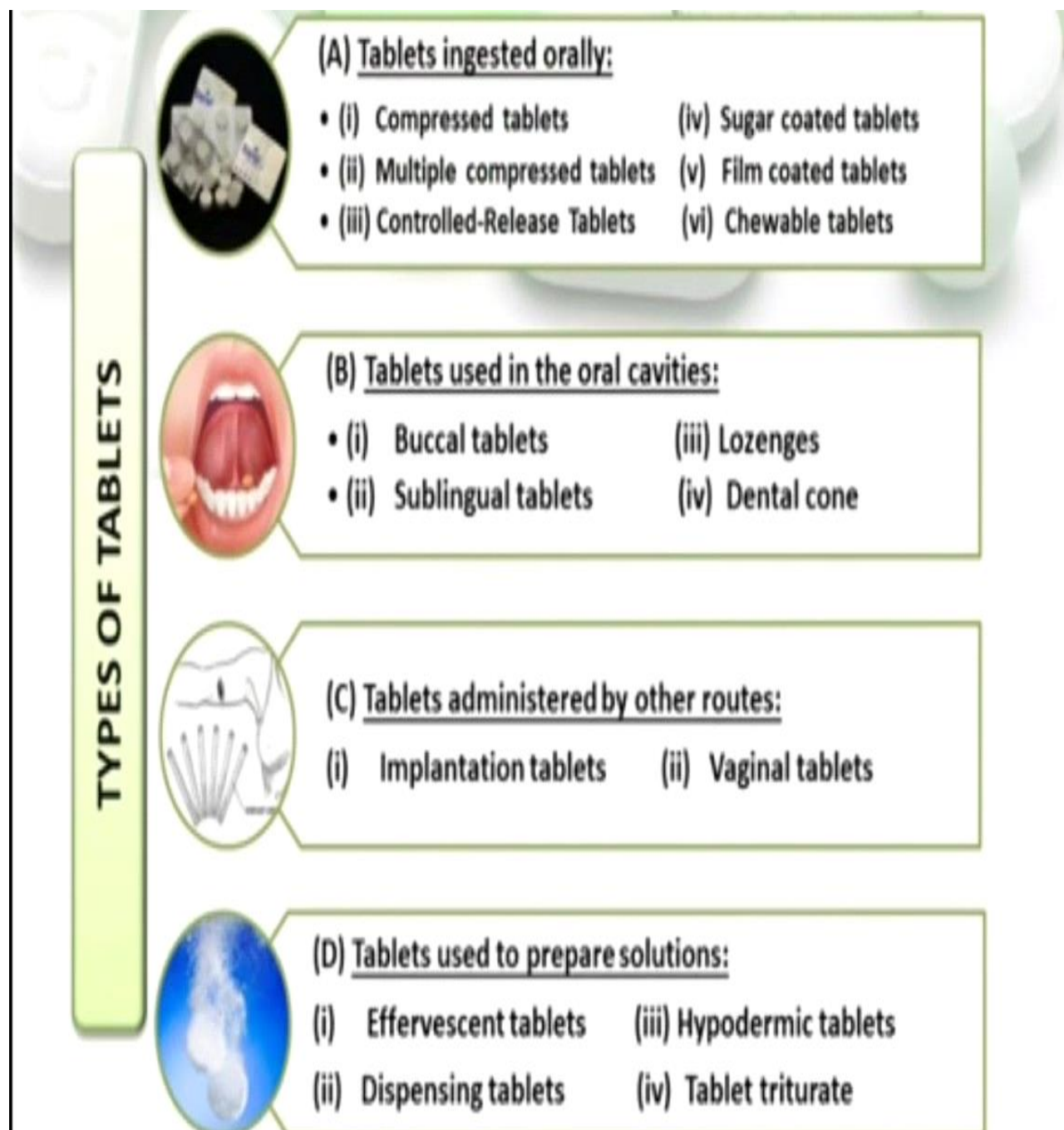
When it comes to systemic effects, the oral route of drug delivery is the most crucial. When treating medical situations involving unconscious or no swallowing patients, the parenteral route of administration plays a crucial role in administering different forms of maintenance medication. However, oral administration accounts for nearly 90% of all pharmaceuticals used to generate systemic effects. When it comes to oral medications, the solid dose form is the recommended product class. A solid dosage form offers the medicine the best defense against changes in temperature, humidity, oxygen, light, and stress while it is being transported. It also guarantees dosing precision, portability, compactness, bland taste, and ease of administration.[4,8]

These tablets are manufactured by many different types of methods and by using many types of required ingredients. Mainly they are made of main active pharmaceutical ingredients (API) with the excipients such as Filler, Binder, Disintegrates, Glidants, Coloring Agents, Coating, Preservative, Antioxidant, Flavoring Agents, Sorbents Solvent & Co-solvent, Buffering Agents, Viscosity imparting Agents, Surface Agents etc.

During the process of manufacture there are several issues have emerged. Which become the reason for defected tablets or Improper tablet is manufactured which also be effective less or do not show any therapeutic action on human body, or also may be quit harmful for patient.[6]



## Types of Tablets



**Particular Issues With Tablet Manufacturing Process:-**

Tablet quality and function may be impacted by a variety of manufacturing flaws that can arise. There are several possible causes of these issues. We've put together a list of typical tablet flaws here. We will also give you effective treatments so that you can make high-quality tablets.[9]

**There are classifications of defects during tablet manufacturing are as follow:-**

**Uncoated tablet.**

- **Due to excipients**
  - Sticking
  - Picking
  - Binding
  - Mottling
  - Chipping
- **During tableting process.**
  - Capping
  - Lamination
  - Cracking
- **Due to compression machine.**
  - Double impression

**Coated tablet**

- Blistering
- Cratering
- Pitting
- Blossoming
- Busting
- Colour variation
- Orange pill [11,17]
- **Other manufacturing defects regarding to the tablets.**
  - Broken
  - Spacks
  - Illegible prints
  - Rough surface
  - Partially coated

- Sticky feel
- Twinning
- Peeling [2]



### ➤ Due to excipients.

#### 1) Sticking:-

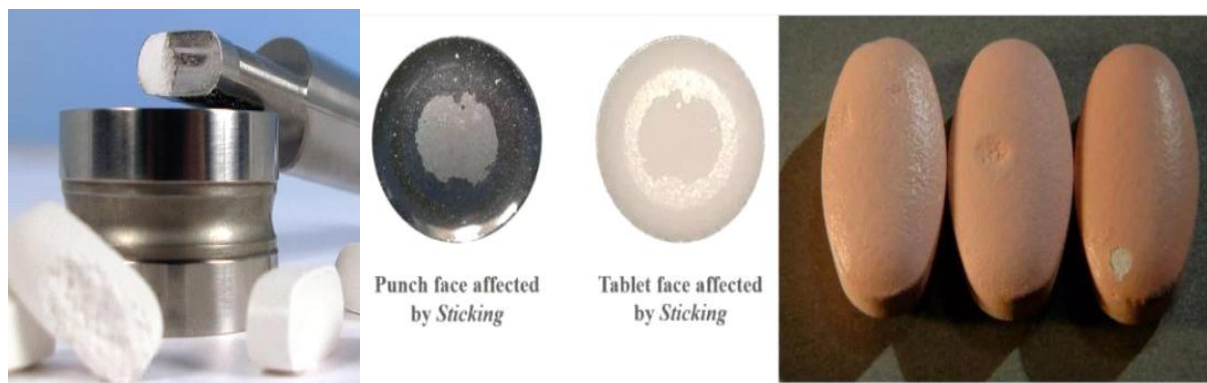
One of the most frequent issues tablet makers deal with is sticking. The accumulation of granules on the punch-tip face is referred to as sticking, and it can be brought on by a number of things, such as the physicochemical qualities of the formulation and the punch face's surface features. Sticking is a common issue for tablet makers, thus tablet tooling specialists have looked into the origins and solutions of this issue in great detail. [30,23]

#### Causes :-

One of the first things to look for when powder sticks in the punch cup or embossed letters is the formulation's moisture content. Sticking or picking can be caused by too much moisture in the formulation or too much humidity in the compression suite.

Another reason for sticking could be insufficient compression force, which results from incomplete powder compaction. When this happens, the cohesive forces of the insufficiently compressed tablet are outweighed by the adhesive forces of the punch. A formulation that contains insufficient lubrication is another possible reason for sticking. More lubrication will cause the compressed tablet to release from the punch cup surface more readily.

It's also crucial to carefully examine the punch cups to make sure there are no surface abrasions that could trap formulation particles. Filming, a first slow type of sticking that is frequently brought on by particles and too much moisture in the granulation, will result from scratches. In the event that surface scratches are found, punches ought to be polished. To add even more lubricity and improved product release qualities, a specific polishing compound can be applied [9,6]



## 2) Picking:-

This results in the tablet's upper surface being struck by one of the punches, eroding the surface. A particular kind of sticking is called picking. It happens when the punch faces with embossing designs have tablet material left on them. Tablet surface damage, partial tablets, and changes in weight and appearance can all be caused by picking. The problem worsens with frequent pill use.

Due to the growing amount of material being introduced to the substance on the punch face that has already been stuck, produce at this tooling station. When punch tips include letter engraving or embossing in addition to the granular material not being completely cured, picking becomes a serious hazard.[10,22]

### Causes:-

- Friction between the tablet and the embossing letter or logos on the punch face is increased when there are insufficient lubricants. So it's very important to use perfect amounts of lubricant.
- There are sticky or cohesive ingredients in the composition. So it's important to use correct amount of excipients.
- The amount of time the punch stays in contact with the tablet material known as dwell time. It's important to ensure that it is not long enough. [29,14]



## 3) Binding:-

Another prevalent issue with tablets is binding. It describes the unfavorable granule adherence to the die surface that occurs during the compression process. Tablet ejection issues, decreased production efficiency, and below usual tablet quality can all be caused by binding.

The causes and remedies of Dies and punches used in binding are made from rough, poorly finished dies used in tablet presses. Due to excessive tablet press pressure, abrasion, undersized dies, poor clearance, and polish In that order, check different steels or materials, modify the granulation, or rework the dies to the proper size, increase clearance, and decrease pressure. [7,4,1]

#### **Causes:-**

- Improper lubrication between the dies and the grain to avoid these type of problem its very important to use proper lubricants.
- The tablet sub sans may stick to the die if there is too much moisture is present. it also become defect during manufacturing.
- The granules are prone to adhesion as well as sticky due to hygroscopic ingredients. [33]

#### **4) Mottling:-**

The term "mottling" describes an unequal dispersion of colours on a tablet, where patches of light or dark hue stand out on a surface that is otherwise smooth. Moreover, a coloured medication whose hue differs from that of the excipients used to make the grate tablet substance. To treat mottling, a colourful medication is used in addition to colourless ones. or excipients with a white hue; an improperly applied dye migrates to the surface of the granulation after drying. Blended colour, especially in "Direct

Compression," mixing a coloured binder solution improperly, using the wrong colouring chemicals, altering the solvent system, Replace the binder. Reduce the drying temperature by using Particle size reduction, thorough mixing, and particle size reduction.[18,20]

#### **Causes:-**

- A colourful medication combined with excipients that are white or colourless.
- As the granulation dries, a dye moves to the surface.
- Dye that has been improperly blended, particularly during "Direct Compression"
- A coloured binder solution that has been improperly mixed.[35,16,1]

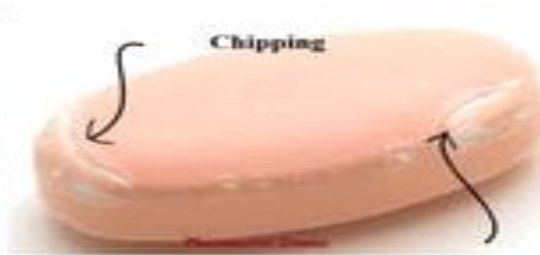
#### **5) Chipping:-**

When a pill breaks along its edges during handling or coating processes after it is taken out of the press, this is referred to as "chipping." The cause may be incorrect machine settings, especially in relation to miss-set ejection take-off. Excessively dry or sticky on punch faces are two categories for the causes of and remedies for chip-related granulation (formation). Granules: Proper drying of the granules prevents bottom chipping caused by excessive binding. Alternatively, enhance binding, incorporate hygroscopic ingredients, wet the granules to plasticize them, or encourage lubrication. [12]

#### **Causes:-**

- Applying glue to punch faces
- Granules that are too dry.
- Overbidding results in bottom chipping [1].

## Chipping



### ➤ .During tableting process.

#### 1) Capping:-

Capping on tablets is the most prevalent flaw. It occurs when the tablet's formed dome breaks apart from the tablet's body.

The granules can lock together when a tablet is compressed because the air between them is forced out. Particles do not adhere to one another well enough if they are very dry, excessively lubricated, or extremely elastic. Small microcracks inside the compact may be opened by the force of ejection, grow, and cause the cap to break away from the body. Typically, the likelihood of a tablet capping increases with manufacturing speed.[17,25]

#### Causes:-

- A substantial number of particles in the granulation
- Extremely low or dry moisture content, which prevents the correct binding process from occurring.
- Granules that have not been fully dried.
- An inadequate or inappropriate quantity of binder.[27,3]



#### 2) Lamination:-

Tablet lamination occurs when the product splits into layers that are horizontal. Similar to capping, lamination can happen right after compression or during the storage phase, however it happens inside the tablet's main body rather than at the top.

To assist you in comprehending the basic compaction characteristics of your product, Merlin has the capability to compress your prototype tablet compositions. Slow-moving tablet characteristics are not necessarily indicative of fast-moving compression. To reduce the risk associated with the development and

scale-up process, we can evaluate the formulation at production-relevant speeds to determine its inclination for tablet capping and lamination. We may also suggest compression science and API characterization, based on the material you wish to test and the application, to find the essential [19,13]

**Causes:-**

- Granulated materials that are oily or waxy.
- Excessive use of hydrophobic grease.
- Stearate of magnesium [19].

**3) Cracking :-**

Tablets with the flaw known as "cracking" have tiny, thin cracks visible on their top and lower central surfaces, and very infrequently, on their sidewalls. Visible at a glance in the dye or pigment tablet. The Causes of Cracks and Their Solutions Granules become excessively large and dry during formulation (granulation), and tablets enlarge. too frigid granulation. It can be addressed with remedies like adding fines and moistening the granules.[34]

**Causes:-**

- Granule size is large.
- Granules that are too dry.
- Tablets get bigger.[4,10]



➤ **Due to compression machine:-**

**1) Double impression :-**

It happens when the tablet material is compressed between several impressions, which causes markings to overlap or duplicate. One of the causes of double impression is incorrect punch alignment inside the die cavity. Punches delivered from lower body rotation are not well controlled. The term "double impression" refers only to punches that feature an engraving, such as a monogram.

Reason: The punch impression is transferred to the tablet at the point of compression. Now, on some machines, the lower punch drops freely and travels erratically for a brief distance before riding up the ejection cam to force the tablet out of the die. The punch rotates during this free travel, and at this point, it might leave a fresh impression on the tablet's bottom. [13,15]

**Causes:-**

When ejecting a tablet, one can freely rotate their upper or lower punch.



**Coated tablet**

**1) Blistering:-**

The tablet coating flaw known as blistering occurs when a piece of film separates from the tablet's surface and forms a blister. It looks like little bubbles on the tablet surface, much like blisters on the skin. [17,5]

**Causes:-**

- Gases or vapour may become trapped in or beneath the film as a result of overheating.
- Effect of high temperature on adhesion and elasticity qualities.
- Overheating during the drying process could be the cause of this. [10]



## 2) Cratering:-

The tablet coating flaw known as "Cratering" occurs when a depression or pit forms on the tablet's surface that mimics a volcano crater. The surface of the core tablet becomes visible due to crater formation.[29,3]

### Causes:-

Coating solution penetration into the tablet core, particularly around the edges, which leads to inadequate drying and core degeneration. The drying temperature is low and the spray rate is excessive.[4]



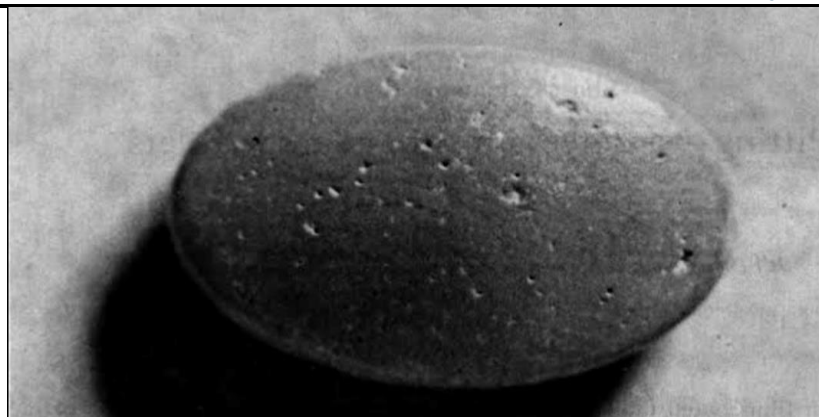
**Cratering**

## 3) Pitting:-

Pitting, commonly referred to as Pitts, is a tablet coating issue. It is a flaw in which coated tablets develop holes the size of tiny needles without causing harm to the coating layer.[28,17]

### Causes:-

- Tablet hardness is low.
- There's a lot of spray rate.
- The pressure of atomization is really strong.
- Bed to gun distance is short.
- The spray rate is modest and the pan speed is very high.[18,7]



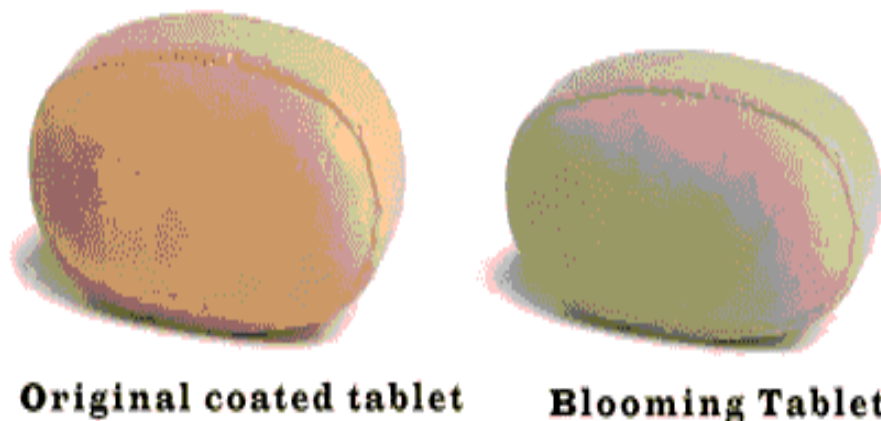
#### 4) Blooming:-

It is a flaw in which the coating either instantly gets dull or takes a long time to dull at high temperatures.

**Reason:** The coating formulation's low molecular weight components are accumulating on their surface. The component will typically be plasticizer.

#### Causes:-

Low molecular weight and high concentration of plasticizer[22]

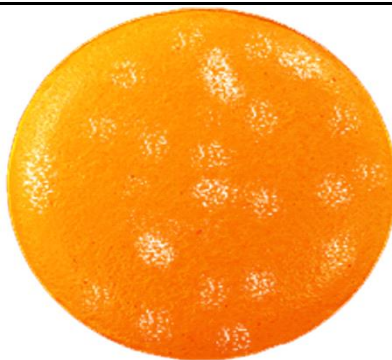


#### 5) Blushing:-

The easiest way to characterize this issue is as haziness or white spots in the It is believed to be caused by precipitated polymer, which is made worse by using a high coating temperature that is either above or below the polymers' thermal gelation temperature.

#### Causes:-

- High temperature of coating.
- The formulation that uses sorbitol results in the biggest drop in the temperature at which hydroxypropyl cellulose, hydroxypropyl methyl cellulose, methyl cellulose, and cellulose ethers thermally gel.[7,2]



**Blushing**

#### 6) Colour variation:-

Colour differences can be caused by a variety of preparation errors, such as inadequate coating, insufficient mixing, uneven machinery spray patterns, and migration of soluble dyes, plasticizers, and other additives during drying.

##### Cause:-

This problem with tablet products has several causes. Variations in colour may arise from inadequate coating, inadequate mixing, or irregular machine spray patterns during the preparation process. Moreover, this fault may also result from the migration of some additives after drying or from soluble dyes and plasticizers.[11,30]



**Color Variation**

#### 7) Orange pill :-

It is a surface imperfection that causes the film to be non-glossy and gritty. The appearance is like to an orange.

##### Reason:

The coating solution was not dispersed evenly enough before drying.

##### Causes:-

- Quick drying
- High viscosity of the solution[14,30]



### **Other Manufacturing defects regarding to the tablets**

There are some basic defects which are raised during the manufacturing process of the tablets.

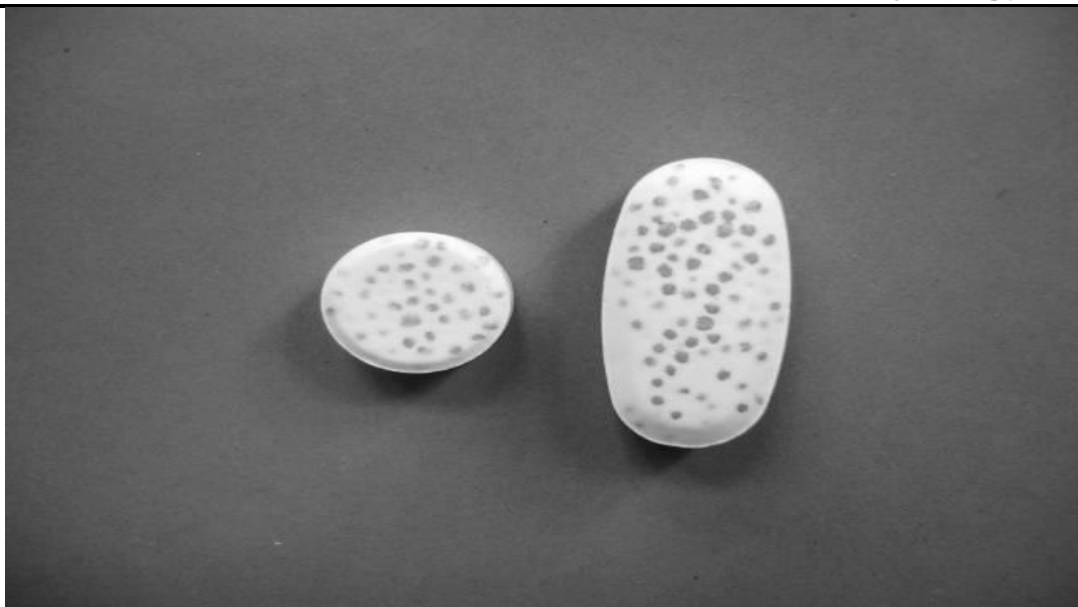
#### **1) Broken:-**

The tablets are completely separated into a substantial parts which is greater then 10% of the unit weight. it is separated into complex parts may be due to the use of less binding agents it is called as Broken .[11,15]



#### **2) Spacks:-**

The foreign compounds, extraneous particles or contaminating agents were attracted on the tablet and it becomes main reason for the production of defected tablet, it can altered the therapeutical effects of the tablet and also can shows the harmful and unwanted action is called as the Spacks defect of tablets. [17]



### 3) Illegible print:-

The problems which are related to the prints, any print defect in which does not resemble the description it is called as Illegible print [1]



### 4) Rough surface:-

The tablets have a rough surface or which contain irregular surface through its process of manufacturing is called as the Rough surface tablet. It can be easily contaminated.[13]



### 5) Partially coated:-

The tablets which are not properly coated with coating solution or which are improperly coated. Mostly tablets are masked with some of the coating material for masking its taste or for prolong release of the

tablet that coating is remain incomplete by the coating material this situation called as Partially coated defect of tablet. [28]



#### 6) Sticky feel :-

when the tablets raw material goes under the process of drying before the manufacturing of tablet. that drying process becomes in improper manner and after that manufactured tablet show the evidence of incomplete or improper drying process is called as Sticky feel defect. [26]



#### 7) Twinning:-

In twinning during the process of masking or coating the tablets by using the machines the tablet were sticks together through coating solution is called as Twinning of tablet. [7]



### 8) Peeling:-

The tablets were coated by the coating solution and after some periods of time the mixture of API and the excipients were separated by the coating agents by peeling this process is called as the Peeling of the tablet. [19]



## CONCLUSION

Out of all the oral dosage forms, tablets are the most widely used and prevalent. This is because it is very inexpensive and simple to administer. Tablet defects may occur during the production process, during storage, or during transportation. These aesthetic flaws may lessen the product's effectiveness and user acceptability. Defects, their causes, and countermeasures have all been covered in this review, along with ways to reduce and avoid them. The main goals of this talk were to identify typical tablet press flaws, find solutions for them at the source, and ultimately fix the issue before it even gets to the tablet press.

## REFERENCES

1. Allen Jr, L.V., 1990. *Pharmaceutical Dosage Forms and Drug Delivery Systems*.
2. Aulton, M.E. and Taylor, K. eds., 2013. *Aulton's pharmaceuticals: the design and manufacture of medicines*. Elsevier Health Sciences.
3. Aulton, M.E., 2002. *Pharmaceutics: The science of dosage form design*. (No Title).
4. Burnside, B., Chang, R.K., Couch, R. and Guo, X., 2000. Fast-dissolving tablets. *Pharm Technol*, 24, pp.52-8.
5. Chemate, S.Z., Godge, G.R., Pawa, K.K. and Rupnar, K.A., 2016. Preparation and evaluation of hollow calcium pectinate beads for floating-pulsatile drug delivery. *Turk J Pharm Sci*, 13(1), pp.91-102.
6. Dash, A. and Singh, S. eds., 2023. *Pharmaceutics: basic principles and application to pharmacy practice*. Elsevier.
7. Gad, S.C. ed., 2008. *Pharmaceutical manufacturing handbook: production and processes* (Vol. 5). John
8. Genaro, A.R., 2000. *Remington: The science and practice of pharmacy*.
9. Godge, G. and Hiremath, S., 2012. Colonic delivery of film coated meloxicam tablets using natural polysaccharide polymer mixture. *Int. Current Pharmaceutical journal*, 1(9), pp.264-71.
10. Godge, G., Labade, S. and Misal, A., 2015. *International Journal of Life Sciences and Review (IJLSR)*.
11. Godge, G.R. and Hiremath, S.N., 2014. An investigation into the characteristics of natural polysaccharide: polymer metoprolol succinate tablets for colonic drug delivery. *Mahidol University Journal of Pharmaceutical Sciences*, 41(2), pp.7-21.

12. Godge, G.R. and Hiremath, S.N., 2014. An investigation into the characteristics of natural polysaccharide: polymer metoprolol succinate tablets for colonic drug delivery. *Mahidol University Journal of Pharmaceutical Sciences*, 41(2), pp.7-21.
13. Godge, G.R. and Hiremath, S.N., 2015. Development and evaluation of colon targeted drug delivery system by using natural polysaccharides/polymers. *Dhaka University Journal of Pharmaceutical Sciences*, 13(1), pp.105-113.
14. Godge, G.R. and Labade, S.P., 2015. Preparation of solid dispersion of poorly water soluble drug formulation and consideration. *Int J Pharm Sci Res (IJPSR)*, 6(5), pp.897-903.
15. Godge, G.R., 2016. Formulation development and in-vitro evaluation of sustained release tablets of telmisartan by solid dispersion technology. *Asian Journal of Pharmaceutical Technology & Innovation*, 4(17), pp.131-139. Wiley & Sons.
16. Godge, G.R., Hiremath, S., Sonawale, B. and Shirsath, R., 2015. Pharmaceutical advances in cyclodextrin inclusion complexes for improved bioavailability of poorly-soluble drugs. *International Journal of Pharmaceutical Sciences and Nanotechnology (IJPSN)*, 8(3), pp.2894-2905.
17. Godge, G.R., Misal, A.V. and Pawar, P.Y., 2015. Formulation and evaluation of mouth dissolving tablet with taste masking resin. *Int J Life Sci Rev (IJLSR)*, 1(7), pp.253-263.
18. Hiremath, S. and Godge, G., 2013. Preparation and in vitro Evaluation of Inclusion Complexes of Nelfinavir with Chemically Modified  $\beta$ -cyclodextrins. *Dhaka Univ J Pharm Sci*, 11(2), pp.107-116.
19. Hiremath, S.N. and Godge, G.R., 2011. Recent advances in pharmaceutical approaches to colon specific drug delivery. *Inventi Impact: Pharm Tech*.
20. Hiremath, S.N., Godge, G.R., Kharia, A.A. and Vaidya, V.R., 2010. Studies on the Preparation, Characterization and Solubility of  $\beta$ -cyclodextrin-Nelfinavir Inclusion complexes. *Asian Journal of Pharmaceutical Research and Health Care*, pp.279-284.
21. Kamble, N.D., Chaudhari, P.S., Oswal, R.J., Kshirsagar, S.S. and Antre, R.V., 2011. Innovations in tablet coating technology: A review.
22. Khan, K.A. and Rhodes, C.T., 1973. Production of tablets by direct compression. *Canadian journal of pharmaceutical sciences*, 8(1), pp.1-5.
23. Khar, R.K., 2013. *Lachman/liebermans: the theory and practice of industrial pharmacy*. Cbs Publishers & Distributors.
24. Kharia, A.A., Hiremath, S.N., Omray, L.K., Yadav, R. and Godge, G.R., 2011. Gastro retentive drug delivery system. *Indian Drugs*, 48(5), pp.7-15.
25. Lachman, L., Lieberman, H.A. and Kanig, J.L., 1976. *The theory and practice of industrial pharmacy* (pp. 210-212). Philadelphia: Lea & Febiger.
26. Mohrle, R., 2005. Effervescent tablets in Liberman H., Lachman L. and Schwartz, J., *Pharmaceutical dosage forms: Tablets*, Volume-1: 285-292, First Indian Reprint.
27. Mounika, A., Sirisha, B. and Rao, V.U.M., 2015. Pharmaceutical mini tablets, its advantages and different enteric coating processes. *World J. Pharm. Pharm. Sci*, 4, pp.523-541.
28. Mute, D.V. and Shelar, T.M., *Tablets Manufacturing Defects and Remedies*.
29. Picta, R., Problems associated with tablet manufacturing, 2011, [Cited 2012 July 17].
30. Rana, A.S. and Kumar, S.H., 2013. Manufacturing defects of tablets-a review. *Journal of Drug Delivery and Therapeutics*, 3(6), pp.200-206.
31. Ranjith, K. and Mahalaxmi, R., 2015. Pharmaceutical mini tablets. *International Journal of PharmTech Research*, 7(3), pp.507-515.
32. Raskar, M.A., Godge, G.R., Chitale, A.B. and Giri, P.D., 2015. Validated simultaneous spectrophotometric estimation of telmisartan, hydrochlorthiazide and amlodipine besylate in combined tablet dosage form. *Der Pharmacia Lettre*, 7(11), pp.120-124.
33. Shah, A., *Coating Tablet Defects: The Cause and The Remedies*, 2011, [Cited 2012 July 17].

## **ACKNOWLEDGEMENT**

Every great work is supported by diligence and sincerity. We are able to learn a great deal of theoretical and practical information over this period of work. Without the assistance of my esteemed advisor, Dr. Neha N. Rajpurohit, our project work would not have been feasible. I appreciate your unwavering encouragement, inspiration, zeal, leadership, and support. We are incredibly appreciative of everyone who has supported us throughout our project work on "DEFECTS OF TABLET MANUFACTURING PROCESS-AN OVERVIEW." We appreciate you. The facilities to carry out this work were provided by Dr. K Raja Rajeshwari, Principal of Vardhaman College of Pharmacy, Koli Karanja (Lad). We would also like to thank all of our esteemed teachers for sharing their knowledge, working with us, and inspiring us throughout this effort. We are grateful to Dr. Varsha Rathod ma'am the Hon. President and Dr. Manoj Jain Sir, the Hon. Secretary, for providing the necessary facilities for us to complete this task.