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# Title: Quality Control Tests for Solid Dosage Forms (review article)

# Quality Control Tests for Solid Dosage Forms

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## ABSTRACT

The main criteria for quality of any drug in solid dosage forms (tablets and capsules) are its safety, potency, efficacy, stability, patient acceptability and regulatory compliance. At the product design and formulation stage the physical, chemical and biological specifications, to which the product must comply with to fulfill quality requirements, have to determine and the target for quality must be set. In-process quality control (IPQC) tests are strongly related to final products quality because checks performed during production in order to monitor and if necessary to adjust the process to ensure that the product conforms to its specification are the key for good quality pharmaceutical tablets. The purposes of IPQC are to produce a perfect finished product by preventing or eliminating errors at every stage in production. After the manufacturing process is complete, finished product quality control (FPQC) tests for pharmaceutical tablets, capsules and suppositories are performed with respect to specification of the pharmacopoeias in order to check that the quality parameters are within acceptance limits or not. The aim of this study is to provide in-process and finished products quality control tests for pharmaceutical tablets and capsules according to pharmacopoeias.

**Key words:** Solid dosage forms, Pharmacopoeia, In-process quality control, finished product quality control, Specification

### 1. INTRODUCTION

Quality is not an accident this is the result of intelligent effort [1]. The quality in the pharmaceutical industry has become a very important and sensitive issue. Since the world has gathered together to unite its practices, guides and the launching of the Food and Drug Administration (FDA) current good manufacturing practices (cGMP) for the 21st century - there has been a growing awareness for the significance of the quality of the pharmaceutical products. In the pharmaceutical industry, it is essential for controlling the errors during the every stage in production process since total quality of the product must be ensured according to compendia of drugs [2].

Manufacturing practices which result in good quality finished products and has adequate considerations for safety of the employees is recognized as

GMP. GMP is concerned with both production and quality control (QC) [3]. QC is the part of GMP by which QC personnel analyses the quality of all factors involved in production in order to eliminate errors at every stage in production. The purposes of QC are to produce a perfect finished product by preventing or eliminating errors at every stage in production. QC is a team work and we have to remember that quality must be built into a drug product during product and process design and it is influenced by the physical plant design, space, ventilation, cleanliness and sanitation during routine production [4].

IPQC tests are performed at regular intervals (generally each 1 hr later) during the manufacturing process [5]. The objectives of IPQC involve monitoring and alteration of the manufacturing process if necessary with a vision to comply with the specifications. The control of the environment or equipment may also be regarded as a part of inprocess control (IPC). They should not carry any risk for the quality of product. In process testing enables easier identification of problems. It sometime identifies a defective product batch that can be corrected by rework, whereas once that batch has been completed, this may not be possible. Failure to meet IPC specification indicates either those procedures were not followed or some factors were out of control [6]. Standard operating procedures (SOPs) should be established in the pharmaceutical industry and followed that describe the IPQCs and tests [7].

FPQCs are tests that are performed when the manufacturing process is completed in order to check qualitative and quantitative characteristics along with test procedures and their acceptance limits by which the finished product must comply throughout its valid shelf-life [8]. In order to determine the specifications of the finished product, the quality characteristics related to the manufacturing process should be taken into account. An appropriate specification for each aspect of quality studied during the phase of development and during the validation of the manufacturing process should be determined. At least those aspects considered to be critical should be the object of specifications routinely verified. The specification limits of the finished product at the time of batch release are set by the marketing authorization applicant such that the specifications proposed at the end of shelf-life are guaranteed and are established on the basis of a critical detailed review of the data gathered from the batches analyzed [9].

Pharmacopoeias are called drugs standard [10]. There are various types of pharmacopoeia such as Indian Pharmacopoeia (IP), British Pharmacopoeia (BP), United States Pharmacopoeia (USP), European Pharmacopoeia (PhEur), International Pharmacopoeia (PhInt) and Japanese Pharmacopoeia (JP) in different parts of the world and they have laid down the specified limits within which the value should fall in order to be compliant as per the

standards. The objective of this study is to show the quality parameters for pharmaceutical tablets and capsules according to pharmacopoeias that are part of in-process and finished products quality control tests.

## UNIVERSAL AND IPQC TESTS

### A) For PHARMACEUTICAL TABLETS

The tablet dosage form accounts for approximately 50% of all dosage forms on the market [11].

### $A_1$) Universal Tests

The tablet dosage form accounts for approximately 50% of all dosage forms on the market [11]. There are four tests that are generally applicable to pharmaceutical tablets and other drug products:

#### 1. Description

This test is often called appearance on a specification and is a qualitative description of the pharmaceutical tablet. For example, the description of a tablet on a specification may read: white, round, biconvex, film-coated tablet, imprinted with ‘‘Rx’’ on one side [11].

#### 2. Identification

The purpose of an identification or identity test is to verify the identity of the active pharmaceutical ingredient (API) in the pharmaceutical tablet. This test should be able to discriminate between compounds of closely related structure that are likely to be present [11].

#### 3. Assay

This test determines the strength or content of the API in the pharmaceutical tablet and is sometimes called a content test [11].

#### 4. Impurities

This test determines the presence of any component that is not the API or an excipient of pharmaceutical tablet. The most common type of impurities that are measured is related substances, which are process impurities from the new drug substance synthesis, degradation products of the API, or both [11].

### $A_2$) IPQC and FPQC Tests

Physical parameters of pharmaceutical tablets that are controlled by IPQC tests are temperature, pressure, moisture content, time, weight, particle size, hardness, loss on drying, disintegration time, color, compactness, integrity etc. FPQC test for pharmaceutical tablets are assay, uniformity of content,

uniformity of mass, weight variation, friability test, content of active ingredients, hardness test, disintegration test, dissolution test etc. IPQC and FPQC test for pharmaceutical tablets according to pharmacopoeias are listed below:

**1. Size and Shape**

The size and shape of the tablet can be dimensionally described monitored and controlled. It is determined by the tooling during the compression process [11].

**2. Color and Odor**

Many pharmaceutical tablets use color as a vital means of rapid identification and consumer acceptance. But it must be uniform within a single tablet, from tablet to tablet and from lot to lot. The presence of an odor in a batch of tablets could indicate a stability problem e.g. the characteristic odor of acetic acid in degrading aspirin tablets or could be characteristic of the drugs e.g. vitamins have a characteristic odor. Taste is important in consumer acceptance of chewable tablets [11].

**3. Unique Identification Markings**

Pharmaceutical companies often use some type of unique markings on tablets in addition to color, for rapid identification of their product these markings utilize some form of embossing, engraving or printing of the company name or symbol or a product code [11].

**4. Moisture Content of Granules**

Granules should possess sufficient strength to withstand normal handling and mixing processes without breaking down and producing large amounts of fine powder. On the other hand, some size reduction during compaction into tablets is desirable to expose the areas of clean surface necessary for optimum bonding to take place so moisture content is the very important factor for producing good pharmaceutical product [11].

**5. Weight Variation Test**

According to the USP weight variation test is run by weighting 20 tablets individually calculating the average weights and comparing the individual tablet weights to the average. The value of weight variation test is expressed in percentage. The following formula is used:

Weight Variation = (Iw - Aw)/Aw X 100%

Where,

Iw = Individual weight of tablet;
Aw = Average weight of tablet.
As per USP the tablet complies with the test if not more than 2 of the individual masses deviate from the average mass by more than the percentage deviation as shown in Table 1 and none deviates by more than twice that percentage [12].

***Table 1: USP limits for weight variation test for uncoated tablets***

| Average Weight (mg) | % deviation |
|---|---|
| 130 mg or less | 10% |
| More than 130 mg and less than 324 mg | 7.5% |
| More than 324 mg | 5% |

## 6. Content uniformity test

It is performed to ensure the proper mixing of the tablet contents by determining individually the content of 10 tablets taken randomly and determine average content. According to USP, content uniformity test is done for uncoated & film-coated tablets containing less than 25% of the total weight and for all sugar coated tablets. Not more than one tablet falls outside the limit 85-115% of the average content and none outside the limit 75-125% of the average content.

## 7. Thickness

The thickness of a tablet is the only dimensional variable related to the process. Thickness of individual tablets may be measured by a micrometer. Other techniques involve placing 5 or 10 tablets in a holding tray, where their total thickness may be measured by a sliding caliper scale. Tablet thickness should be controlled within a ± 5 % variation of a standard. Thickness must be controlled to facilitate packaging. It is expressed in mm.

## 8. Hardness Test

For this test one of the earliest testers was Ketan tablet hardness tester, which is a type of the Monsanto hardness tester to evaluate tablet hardness tester. The tester consists of a barrel containing a compressible spring held between two plungers. The lower plunger is placed in contact with the tablet and zero reading is taken. The upper plunger is then forced against a spring by turning a threaded bolt until the tablet fractures. As the spring is compressed, a pointer rides along a gauge in the barrel to indicate the force. The force of fracture is recorded in kilogram [13]. Ten tablets are crushed and measure their hardness and the allowable range is between 4 - 6 kg (40 - 60 N) unless otherwise specified.

## 9. Friability Test

Friability of a tablet can determine in laboratory by Roche friabilator. For this test twenty tablets are weighed and placed in the friabilator and then operated at 25 rpm for 4 minutes. The tablets are then dedusted and weighed. The difference in the two weights is used to calculate friability and the value of friability is expressed in percentage. It is determined by the following formula: Friability = (Iw - Fw)/Iw x 100%

Where, Iw = Total Initial weight of tablets; Fw = Total final weight of tablets.

As stated by USP if conventional compressed tablets that loss less than 0.5 % to 1 % (after 100 revolutions) of their weight are generally considered acceptable [14].

**10. Disintegration Test:** The USP disintegration apparatus consist of 6 glass tubes that are 3 inches long, open at the top, and held against a 10-mesh screen at the bottom end of the basket rack assembly. To test for disintegration time, one tablet is placed in each tube and the basket rack is positioned in specified medium at 37 ± 2 °C such that tablet remains 2.5 cm below the surface of the liquid on their upward movement and descend not closer than 2.5 cm from the bottom of the beaker. A standard motor driven device is used to move the basket assembly containing the tablets up and down through distance of 5 to 6 cm at a frequency of 28 to 32 cycles per minute. Perforated plastic discs may also be used in the test. These are placed on the top of tablets and impart an abrasive action to the tablets. The discs may or may not be meaningful or impart more sensitivity to the test, but they are useful for tablets that float. Operate the apparatus for the specified time (15 minutes for uncoated tablet unless otherwise justified and authorized) [14].

The tablet complies with the test, if the tablets disintegrate, and all particles pass through the 10-mesh screen in the time specified. If any residue remains, it must have a soft mass with no palpably firm core. The tablet complies with the test according to USP, if all of the tablets have disintegrated completely. If 1 or 2 tablets fail to disintegrate completely, repeat the test on 12 additional tablets. The requirement is met if not less than 16 of the total of 18 tablets tested are disintegrated [14]. The BP limits for disintegration times of tablets are given in Table 2 [15].

***Tablet 2: BP limits for disintegration times of tablets***

| Categories of Tablets | Disintegration Time (min) |
|---|---|
| Uncoated tablets | 15 |
| Coated tablets | 60 |
| Effervescent tablets | 5 |
| Soluble tablets | 3 |
| Dispersible tablets | 3 |
| Orodispersible tablets | 3 |

| | |
|---|---|
| Gastro-resistant tablets | 60 |
| Oral lyophilisates | 3 |

## 11. Dissolution Test

The BP or USP dissolution apparatus (Basket apparatus) consist of a cylindrical vessel with a hemispherical bottom, which may be covered, made of glass or other inert, transparent material; a motor; a metallic drive shaft; and a cylindrical basket. The vessel is partially immersed in a suitable water bath of any convenient size or heated by a suitable device such as a heating jacket. The water bath or heating device permits holding the temperature inside the vessel at 37 ± 0.5 °C during the test and keeping the bath fluid in constant, smooth motion [14,15].

For this test according to BP and PhEur place the stated volume of the dissolution medium (± 1 %) in the vessel of the specified apparatus. Assemble the apparatus, equilibrate the dissolution medium to 37 ± 0.5 °C. Place 1 tablet in the apparatus, taking care to exclude air bubbles from the surface of the tablet. Operate the apparatus at the specified rate. Within the time interval specified, or at each of the times stated, withdraw a specimen from a zone midway between the surface of the dissolution medium and the top of the rotating basket or blade, not less than 1 cm from the vessel wall. Where multiple sampling times are specified, replace the aliquots withdrawn for analysis with equal volumes of fresh dissolution medium at 37 °C or, where it can be shown that replacement of the medium is not necessary, correct for the volume change in the calculation. Keep the vessel covered for the duration of the test and verify the temperature of the medium at suitable times. Perform the analysis using a suitable assay method as directed in the individual monograph. Repeat the test with additional tablets. Unless otherwise specified in the individual monograph, according to BP, USP, PhEur, JP and PhInt the requirements are met if the quantities of active ingredient dissolved from the tablets tested conform to the following acceptance criteria (Table 3) [14,15, 16, 17, 18].

***Table 3: BP, USP, PhEur, JP and PhInt acceptance criteria for dissolution test of tablet***

| Stage | No. of tablet tested | Acceptance criteria |
|---|---|---|
| S1 | 6 | Each unit is not less than Q + 5 %. |
| S2 | 6 | Average of 12 units (S1 + S2) is equal to or greater than Q, and no unit is less than Q – 15 %. |
| S3 | 12 | Average of 24 units (S1 + S2 + S3) is equal to or greater than Q, not more than 2 units are less than Q – 15 %, and no unit is less than Q – 25 %. |

Continue testing through the 3 stages unless the results conform at either S1 or S2. The quantity Q, is the specified amount of dissolved active substance, expressed as a percentage of the labeled content; the 5 percent, 15 percent, and 25 percent values in

the table are percentages of the labeled content so that these values and Q are in the same terms [14, 15, 16, 17, 18].

**B) For PHARMACEUTICAL CAPSULES**

Physical parameters of pharmaceutical capsules that are controlled by IPQC tests are temperature, pressure, relative humidity, particle size, color, fill weight, shell weight, soft gel ribbon thickness, soft gel seal thickness, soft gel shell moisture level, soft gel hardness, disintegration time etc. FPQC test for pharmaceutical capsules are assay, fill weight, uniformity of content, uniformity of mass, mass variation, microbiological test, disintegration test, dissolution test, stability test etc [19].

**$B_1$) UNIVERSAL TESTS**

The capsule dosage form accounts for approximately 10% of all dosage forms on the market. There are four tests that are generally applicable to pharmaceutical capsules and other drug products:

**1. Description**

This test is often called appearance on a specification and is a qualitative description of the pharmaceutical capsules. For example, the description of a capsule on a specification may read: white cap, red body, imprinted with ‘‘Rx’’ on cap.

**2. Identification**

The purpose of an identification or identity test is to verify the identity of the API in the pharmaceutical capsule. This test should be able to discriminate between compounds of closely related structure that are likely to be present.

**3. Assay**

This test determines the strength or content of the API in the pharmaceutical capsule and is sometimes called a content test [24].

**4. Impurities**

This test determines the presence of any component that is not the API or an excipient of pharmaceutical capsule. The most common type of impurities that are measured is related substances, which are process impurities from the new drug substance synthesis, degradation products of the API, or both.

**$B_2$) IPQC AND FPQC TESTS**

**1. Appearance**

Capsules produced on a small or a large scale should be uniform in appearance. Visual or electronic inspection should be undertaken to detect any flaws in the integrity and appearance of the capsule. Evidence of physical instability is demonstrated by gross changes in appearance, including hardening or softening, cracking, swelling, mottling, printing mistake or discoloration of the shell. Defective capsules should be rejected [20].

**2. Size and Shape**

Hard capsules are made in a range of sizes, the standard industrial ones in use today for human medicines range from size from 000 (the largest, 1.40 ml) to 5 (the smallest, 0.13 ml) are commercially available. Soft gel capsules are available in variety of shapes such as spherical (0.05–5 ml), ovoid (0.05–7 ml), cylindrical (0.15– 25 ml), tubes (0.5–0 ml), pear (0.3–5 ml) etc [20].

**3. Unique Identification Markings**

Capsule surfaces may bear symbols or other unique identification markings for better identification.

**4. Assay**

In a capsule an active ingredient is present which is called API. So to prepare the capsule assay has to be done by using suitable analytical method to produce good finished product.

**5. Content of Active Ingredients**

For this test a sample of the contents is assayed as described in individual monographs and calculates the amount of active ingredient in each capsule. According to IP the range for the content of active ingredient stated in the monograph is based on the requirement that 20 capsules, or such other number as may be indicated in the monograph, are used in the assay. In the circumstances where 20 capsules cannot be obtained, a smaller number, which must not be less than 5, may be used, but to allow for sampling errors the tolerances are widened in accordance with Table 4 [21].

The requirements of the Table 1 apply when the stated limits are between 90 and 110 percent. For limits other than 90 to 110 percent, proportionately smaller or larger allowances should be made [21].

***Table 4: IP limits for content of active ingredients***

| **Weight of active ingredients in each capsule (g)** | **Subtract from lower limit for samples of** | | | **Add to the upper limit for samples of** | | |
|---|---|---|---|---|---|---|
| | 15 | 10 | 5 | 15 | 10 | 5 |
| **0.12 or less** | 0.2 | 0.7 | 1.5 | 0.3 | 0.8 | 1.8 |
| **More than 0.12 But less** | 0.2 | 0.5 | 1.2 | 0.3 | 06 | 1.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **than 0.3** | | | | | | |
| **0.3 or more** | 0.1 | 0.2 | 0.8 | 0.2 | 0.4 | 1.0 |

## 6. Content Uniformity Test

For this test according to BP determine the content of the active ingredient in each of 10 capsules (hard or soft) taken at random using the method given in the monograph or by any other suitable analytical method of equivalent accuracy and precision. Calculate the acceptance value (AV) using the following formula:

$$\left| \mathbf{M - X} \right| + \mathbf{KS}$$

Where,

M = Reference value. X = Mean of individual content (x1, x2,..., xn) expressed as percentage of the label claim. K = Acceptability constant. S = Sample standard deviation [14].

As per BP capsules comply with the test if not more than one of the individual values thus obtained is outside the limits 85 to 115 percent of the average value and none is outside the limits 75 to 125 percent. The capsules fails to comply with the test if more than 3 individual contents are outside the limits of 85 percent to 115 percent of the average content or if one or more individual contents are outside the limits of 75 percent to 125 per cent of the average content. If 2 or 3 individual values are outside the limits 85 to 115 percent of the average values, repeat the determination using another 20 capsules. The capsules comply with the test if in the total sample of 30 capsules not more than 3 individual values are outside the limits 85 to 115 percent and none is outside the limits 75 to 125 percent of the average value [28].

As stated by IP, BP, USP and PhEur limits for content uniformity (CU) and mass variation (MV) tests of capsules are given in Table 5 [14, 15, 16 , 21].

According to IP this test is not applicable for capsules containing multivitamins and trace elements [14].

***Table 5: IP, BP, USP and PhEur limits for content uniformity (CU) and mass variation (MV) tests***

| **Capsule** | **Dose and ratio of active substance** | |
|---|---|---|
| | ≥ 25 mg and ≥ 25 % | < 25 mg or < 25 % |
| **Hard** | MV | CU |
| **Soft** | CU | CU |

## 7. Uniformity of Mass

For this test weigh an intact capsule. Open the capsule without losing any part of the shell and remove the contents as completely as possible. To remove the contents of a soft capsule the shell may be washed with ether or other suitable solvent and the shell allowed to stand until the odor of the solvent is no longer perceptible. Weigh the shell. The weight of the contents is the difference between the weighing. Repeat the procedure with a further 19 capsules. Determine the average mass. According to IP, BP, PhEur and PhInt capsules not more than 2 of the individual masses deviate from the average mass by more than the percentage deviation shown in the Table 6 and Table 7 respectively and none deviates by more than twice that percentage [15, 16, 18, 21].

***Table 6: IP, BP, and PhEur limits for uniformity of mass***

| Average mass (mg) | Percentage deviation (%) |
|---|---|
| Less than 300 | 10 |
| 300 or more | 7.5 |

***Table 7: PhInt limits for uniformity of mass***

| Net mass (mg) | Percentage deviation (%) | Number of capsules |
|---|---|---|
| Less than 300 | 10 | Minimum 18 |
| | 20 | Maximum 2 |
| 300 or more | 7.5 | Minimum 18 |
| | 15 | Maximum 2 |

## 8. Mass Variation Test

For hard capsules according to BP accurately weigh 10 capsules individually, taking care to preserve the identity of each capsule. Remove the contents of each capsule by suitable means. Accurately weigh the emptied shells individually, and calculate for each capsule the net mass of its contents by subtracting the mass of the shell from the respective gross mass. Calculate the active substance content in each capsule from the mass of product removed from the individual capsules and the result of the assay. Calculate the AV using the following formula:

$Xi = Wi \times A/W$

Where,

x1, x2,..., xn = Individual estimated contents of the dosage units tested. w1, w2,..., wn = Individual masses of the dosage units tested. A =

Content of active substance (percentage of label claim) obtained using an appropriate analytical method (assay). W = Mean of individual weights (w1, w2,..., wn) [15].

For soft capsules consistent with BP accurately weigh 10 intact capsules individually to obtain their gross masses, taking care to preserve the identity of each capsule. Then cut open the capsules by means of a suitable clean, dry cutting instrument such as scissors or a sharp open blade, and remove the contents by washing with a suitable solvent. Allow the occluded solvent to evaporate from the shells at room temperature over a period of about 30 min, taking precautions to avoid uptake or loss of moisture. Weigh the individual shells, and calculate the net contents. Calculate the active substance content in each capsule from the mass of product removed from the individual capsules and the result of the assay. Calculate the AV using the following formula given above [15]

According to BP and USP, the requirement is met if the acceptance value of 10 capsules is less than or equal to 15 percent. If acceptance value is greater than 15 percent, test the next 20 capsule and calculate the acceptance value. The requirements are met if the final acceptance value of the 30 capsule is less than or equal to 15 percent and no individual content of the capsule is less than $(1 - 25 \times 0.01)$ M or more than $(1 + 25 \times 0.01)$ M in calculation of acceptance value under mass variation or content uniformity [14, 15].

**9. Disintegration Test**

The USP disintegration apparatus consist of 6 glass tubes that are 3 inches long, open at the top, and held against a 10-mesh screen at the bottom end of the basket rack assembly. To test for disintegration time, one capsule is placed in each tube and the basket rack is positioned in specified medium at 37±2ºC such that capsule remains 2.5 cm below the surface of the liquid on their upward movement and descend not closer than 2.5 cm from the bottom of the beaker. A standard motor driven device is used to move the basket assembly containing the capsules up and down through distance of 5 to 6 cm at a frequency of 28 to 32 cycles per minute. Perforated plastic discs may also be used in the test. These are placed on the top of capsules and impart an abrasive action to the capsules. The discs may or may not be meaningful or impart more sensitivity to the test, but they are useful for capsules that float. Operate the apparatus for the specified time. The capsule complies with the test, if the capsules disintegrate, and all particles pass through the 10-mesh screen in the time specified. If any residue remains, it must have a soft mass with no palpably firm core [21].

The capsule complies with the test according to USP, if all of the capsules have disintegrated completely. If 1 or 2 capsules fail to disintegrate

completely, repeat the test on 12 additional capsules. The requirement is met if not less than 16 of the total of 18 capsules tested are disintegrated [21]. According to IP and BP the disintegration time of various capsules is given in Table 8 and Table 9 respectively [14, 15].

***Table 8: Disintegration time of various capsules according to IP***

| Capsule | Disintegration time (min) |
|---|---|
| Hard capsule | 30 |
| Soft capsule | 60 |
| Enteric capsules | 60 |

***Table 9: Disintegration time of various capsules according to BP***

| Capsule | Disintegration time (min) |
|---|---|
| Hard capsule | 30 |
| Soft capsule | 30 |
| Gastro resistance capsule | 60 |
| Rectal capsules | 30 |
| Vaginal capsules | 30 |

According to IP the disintegration test is not applicable to modified-release capsules. For those hard or soft capsules for which a requirement for dissolution is included in the individual monograph, the requirement for disintegration does not apply [21]. As said by BP apparatus A is used for capsules that are not greater than 18 mm long and for larger capsules apparatus B is used [15].

## 10. Dissolution Test

The BP or USP dissolution apparatus (Basket apparatus) consist of a cylindrical vessel with a hemispherical bottom, which may be covered, made of glass or other inert, transparent material; a motor; a metallic drive shaft; and a cylindrical basket. The vessel is partially immersed in a suitable water bath of any convenient size or heated by a suitable device such as a heating jacket. The water bath or heating device permits holding the temperature inside the vessel at 37±0.5°C during the test and keeping the bath fluid in constant, smooth motion [14, 15].

For this test as per BP and PhEur place the stated volume of the dissolution medium (±1%) in the vessel of the specified apparatus. Assemble the apparatus, equilibrate the dissolution medium to 37±0.5°C. Place 1 capsules in the apparatus, taking care to exclude air bubbles from the surface of the capsules. Operate the apparatus at the specified rate. Within the time interval specified, or at each of the times stated, withdraw a specimen from a zone midway between the surface of the dissolution medium and the top of the

rotating basket or blade, not less than 1 cm from the vessel wall. Where multiple sampling times are specified, replace the aliquots withdrawn for analysis with equal volumes of fresh dissolution medium at 37°C or, where it can be shown that replacement of the medium is not necessary, correct for the volume change in the calculation. Keep the vessel covered for the duration of the test and verify the temperature of the medium at suitable times. Perform the analysis using a suitable assay method as directed in the individual monograph. Repeat the test with additional capsules. According to BP, USP, PhEur, PhInt and JP unless otherwise specified in the individual monograph, the requirements are met if the quantities of active ingredient dissolved from the capsules tested conform to the following acceptance criteria as shown in Table 10 [14-18].

Continue testing through the 3 stages unless the results conform at either S1 or S2. The quantity Q, is the specified amount of dissolved active substance, expressed as a percentage of the labeled content; the 5 percent, 15 percent, and 25 percent values in the capsule are percentages of the labeled content so that these values and Q are in the same terms [14-18].

***Table 10: BP, USP, PhEur, PhInt and JP acceptance criteria for dissolution test of capsule***

| Stage | No. of capsule tested | Acceptance criteria |
|---|---|---|
| S1 | 6 | Each unit is not less than Q + 5%. |
| S2 | 6 | Average of 12 units (S1 + S2) is equal to or greater than Q, and no unit is less than Q – 15%. |
| S3 | 12 | Average of 24 units (S1 + S2 + S3) is equal to or greater than Q, not more than 2 units are less than Q – 15%, and no unit is less than Q – 25%. |

## 11. Moisture Permeation Test

The USP requires determination of the moisture permeation characteristics of single-unit and unit dose containers to ensure their suitability for packaging capsules. The degree and rate of moisture penetration are determined by packaging the dosage unit together with a color revealing desiccant pellet, exposing the packaged unit to known relative humidity over a specified time, observing the desiccant pellet for color change. Any change in color indicates absorption of moisture. By measuring pretest weight and protest weight of pellet, amount can be calculated [12, 22, 23].

## 12. Stability Test

The capsule manufacturers routinely conduct accelerated physical stability tests on all new capsule products as an integral part of the product development program. The following tests have proved adequate for determining the effect of the capsule shell content on the gelatin shell. The

tests are strictly relevant to the integrity of the gelatin shell and should not be confused as stability tests for the active ingredients in the capsule content. The results of such tests are used as a guide for the reformulation of the capsule content or the capsule shell, or for the selection of the proper retail package. The test conditions for such accelerated stability tests are shown in above, Table 8. The capsules at these stations are observed periodically for 2 weeks. Both gross and subtle effects of the storage conditions on the capsule shell are noted and recorded. The control capsule should not be affected except at the 80 percent RH (relative humidity) station, where the capsule would react as described under the effects of high humidity [22, 23].

## CONCLUSION

To ensure the quality of pharmaceuticals regulatory bodies are continually developing their requirements toward pharmaceutical companies. In pharmaceutical industry the maximum quality of pharmaceuticals, depends on the tests performed during manufacturing and after manufacturing of the pharmaceuticals as per specifications of the respective pharmacopoeias and the regulatory requirements of the particular countries. From the present study it is clearly revealed though various pharmacopoeias suggest different types of IPQC tests for pharmaceutical tablets and capsules with different specifications and standards but the main function of the all pharmacopoeias is to assure the maximum quality of pharmaceuticals for human health.

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