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ORIGINAL ARTICLE **OPEN ACCESS**

Formulation and *In Vitro* Evaluation of Bilayer Tablets of Bicalutamide and Curcumin

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ABSTRACT
Prostate cancer has been called a "disease of the industrialized world," and statistics seem to bear this out. More over half of the 307,471 men who lost their lives to prostate cancer that year were not from the United States or Europe. The purpose of this study was to develop, optimize, and in-vitro evaluate a bilayer tablet containing curcumin (CCM) in the immediate release layer and bicalutamide (BCT) in the sustained release layer, using sodium starch glycolate as a super disintegrant for the IRL and the hydrophilic matrix HPMC-K100 for the SRL. The bilayer tablet demonstrated an early burst action to supply a dosage of immediate release layer Curcumin to lower acid secretion level and sustained release of bicalutamide over 24 hours. The physical properties of the prepared bilayer tablets were evaluated, including their hardness, friability, weight uniformity, drug content uniformity, swelling index, and in-vitro drug release, in addition to the precompression parameters. Over the course of 45 minutes, 98.870.15% of the curcumin in the topmost immediate release layer was determined to have leaked away. The slow-release layer's bicalutamide concentration dropped by 97.32% during the course of 24 hours. The effectiveness of bicalutamide is enhanced by curcumin. So, bilayer tablets containing curcumin and bicalutamide were used to increase the number of men with prostate cancer who took their medication.
Keywords: *Prostate cancer, Curcumin, Bicalutamide, Bilayer Tablets*

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INTRODUCTION

When it comes to male cancers, prostate cancer is by far the most common worldwide. Extreme variations in the likelihood of getting prostate cancer and dying from the disease exist between different communities around the world [1]. Cancer of the prostate is the second most common type of cancer and the fifth biggest cause of death among men globally. Between those years, the average yearly death toll rose from 150,000 to 250,000. In 2018, there were allegedly 1,276,106 new cases and 359,010 deaths [2]. Transmission techniques for diseases vary greatly between countries. In numerous countries in Europe, Australia, the Americas, and Africa, it is quite common among men. However, the prevalence of prostate cancer is much lower in Asia. Prostate cancer risk factors include heredity, excess body fat, advanced age, and racial or ethnic background [3-5]. Prostate cancer begins in the prostate gland, where the cancerous cells first develop. In the United States, this is the second largest cause of mortality for men. Most men are at least 66 years old when they are told they have prostate cancer. Even yet, if several risk factors are present, it can arise in the late 40s or earlier [6].

Curcumin can also be referred as by its chemical name, diferuloylmethane. Potentially, it could serve as a cancer preventive. You can find this polyphenolic compound in the rhizome of the Curcuma longa plant. This naturally occurring, yellow compound is frequently used in curry recipes. Because of its anti-inflammatory effects, it has a long history of use in Ayurvedic, Chinese, and Hindu medicine. There have been extensive efforts to understand its peculiar behaviour. Multiple studies have shown that curcumin has antimicrobial, antioxidant, anti-inflammatory, anti-proliferative, and anti-angiogenic activities. Research on curcumin in humans is currently being tested. Most of the questions are about malignant diseases like cancer. [7-9].

Pure nonsteroidal antiandrogen bicalutamide is used to treat localised, early-stage prostate cancer that has not spread to other parts of the body. Bicalutamide monotherapy consists of a single 150 mg dose taken once daily. There is no significant difference in anti-androgen activity between the two enantiomers of bicalutamide, which are both racemates. Inactive or little activity of the (S)-enantiomer. Without or with food in the stomach, (R)-bicalutamide absorption is about average. Half of the plasma is gone after approximately a week, and if it is given every day, the concentration rises to nearly ten times the normal amount. Bicalutamide, marketed under the brand name Casodex, is a nonsteroidal antiandrogen that blocks the effects of androgens by binding to the androgen receptor. An rise in both testosterone and oestrogen is shown when bicalutamide is used [10-13]. The estradiol levels are extremely close to what a woman would experience before menopause.

Because of its many advantages over conventional tablets, bilayer tableting has become increasingly common in recent years. A drug's concentration in the body's blood and tissues can be drastically altered by switching from its typical dosing form. These changes raise safety concerns and decrease the drug's effectiveness. Controlled drug delivery systems were created because of problems with conventional drug administration, such as the need to provide the same dose repeatedly and the uncertainty of drug absorption. Manufacturers have long been able to make pharmaceuticals with multiple effects by using the concept of a two-layer tablet, wherein one layer dissolves quickly and the second layer dissolves slowly over time. Rapid drug distribution from the drug delivery system's first layer allows for rapid elevation of serum drug concentration. Loading doses are a specific kind of dosage. [14–16] One layer of a bilayer tablet is designed to slow-release the drug over time, keeping the drug's concentration within the therapeutic index. One of the most important components of cancer treatment is combination therapy, which involves the administration of two or more therapeutic drugs at once. Drug combinations that target multiple cancer-related pathways at once are more effective than using any one of them alone. If successful, this strategy could reduce the risk of the body developing drug resistance while treating cancer. This is achieved by restricting tumour expansion and metastasis, stopping cell duplication, reducing the number of cancer stem cells, and ultimately killing them [17-19].

In this study, scientists attempted to construct bilayer tablets containing curcumin and bicalutamide by combining an oral dose form that allows curcumin to begin functioning rapidly and maintains bicalutamide for 24 hours. In order to enhance the oral bioavailability of bicalutamide. This study's major purpose was to develop a simple formulation procedure for mass-producing bilayer tablets containing two different types of medication.

MATERIALS AND METHODS

Free samples of Bicalutamide were generously provided by Cipla ltd. in Goa, India. In Mumbai, Helax Health Medicines gave away free curcumin and other supplements (India). With headquarters in Hyderabad, India, Aurobindo Pharma donated both Xanthan gum and HPMC-K100. The lactose monohydrate and sodium starch glycolate came from SD Fine Chemicals in Mumbai, India. Polyvinyl pyrrolidone and sodium starch glycolate were provided by Medibios Pharmaceuticals, which is located in Bhoisar in the Mumbai suburb of Mumbai (India),

Compatibility studies of drug and polymers

Fourier transform infrared spectrometry (FTIR)

About 300mg of KBr was weighed and ground into a fine powder, and then about 1mg of the pure drug/combination of drug-excipients was added and ground well to mix the sample with the KBr, which was then pressed using an IR press at a pressure of 8 tonnes [12].

Differential Scanning Calorimetry (DSC)

The DSC investigation validated the nanoparticles' inherent medication's physical characteristics. The sample was examined between 25 °C and 300 °C with a heating rate of 10 °C per minute and a nitrogen atmosphere at a rate of 10 °C per minute. A reference aluminium pan was used [13].

Preparation and optimization of bilayer tablets

Preparation of Immediate Release Curcumin Granules

Curcumin granules were created by wet granulation and had an immediate therapeutic impact. To increase their level of productivity, this was done. The curcumin and any additional excipients, such as xanthan gum, sodium starch glycolate, and Dicalcium phosphate, that were to be utilised were weighed, measured, and then put in a polybag before being filtered using sieve #40. The sifted powders were thoroughly mixed for 5 minutes, and then sieve #40 was used to ensure that all of the particles were the same size. Magnesium stearate was added to the powder combination after sieving using sieve #40 to make it less sticky. With the use of equipment with ten compression stations, granules were compressed. **Table 1** contains a list of the components used in each pill. Improved and newer curcumin pills have an

immediate effect. The completed bilayer tablets were created using the most effective mixture of components.

Preparation of Sustained Release Bicalutamide solid dispersions Tablets

Using the solvent evaporation approach, Bicalutamide solid dispersions were created in the first step of the procedure. In a variety of ratios, polymers (PEG-20000) were completely dissolved in ethanol in a beaker during this step. At a ratio of 1:4 drug to polymer, bicalutamide was evenly distributed throughout the solution. To remove the solvent from the final mixture, the solution was placed on the water bath, which was kept at 60 ± 0.50 degrees Celsius. The collected material was then dried. Using a glass mortar and pestle, the resulting material was ground into a fine powder. After passing the pulverized material through a sieve with a mesh size of 60, it was weighed and placed in the glass vials.

In the second phase, a wet granulation technique was utilised to produce a sustained release layer of bicalutamide solid dispersion. This was accomplished by combining lactose monohydrate, sodium starch glycolate, polyvinyl pyrolidone, and xanthan gum. After carefully weighing the necessary amounts of bicalutamide solid dispersions and other excipients, the materials were filtered through a #40 sieve, thoroughly blended, and then a sufficient volume of binding agent was added slowly to make a cohesive mass. The material was then passed through filter #20 in order to extract the granules. The granules were then dried in an oven at 50 degrees Celsius with hot air until they were completely dry. After lubricating the dried granules uniformly with magnesium stearate, talc was added and well mixed in. On a 10-station tablet compression machine (Mini Press I, Karnavati and Gujarat, India), the granules were punched through with a 9 mm punch [15-18].

Preparation of Bilayer Tablets [19]

Development of the Bilayer Tablet Both the instant-release layer (N-2, Curcumin) and the controlled-release layer (NA-4, Bicalutamide) of bilayer tablets are optimized. The immediate layer of curcumin was refined using the wet granulation method. The technique of wet granulation was employed to develop an effective and safe sustained-release coating of Bicalutamide. A coating of immediate-release Curcumin was positioned in the lower die cavity and then gently compressed using a punch. After inserting the Sustained Release Bicalutamide Solid Dispersions Tablets into the lower die cavity, the Upper die cavity was filled with the Immediate Release Curcumin Layer, and the tablets were punched to a hardness of 6-8 kg/cm2. Punches of 10 mm were utilised to achieve the compression (Mini Press I, Karnavati, Gujarat, India). Each bilayer tablet now contains 100 mg of curcumin in the fast-release layer and 50 mg of bicalutamide in the extended-release layer, for a total weight of 400 mg. [16, 17]. The produced bilayer tablets were subjected to in vitro dissolution studies and post-compression investigations.

Characterization parameters

Appearance:

The appearance was acknowledged visually through proving the colour variance.

Hardness:

You can determine how well a tablet will stand up by applying enough force to it when it is on its edge. These days, the market is flooded with hardness testers. Just two of them are Mosanto and Pfizer. Uncoated tablet hardness should be at least 5 kg for mechanical stability. The hardness of a substance is influenced by the binders, the force of compression, and the hardness and deformation of the granules under load. Hardness may impact bioavailability because it affects how long it takes for something to disintegrate or break down.

Thickness:

Ten randomly selected tablets were measured for thickness using a Mitutoyo Digital Vernier calliper [18]. You can precisely gauge a tablet's thickness with a micrometer, which provides you with important knowledge regarding the range of tablet thicknesses. A nominal value must be within 5% of the amount of thickening.

Friability:

The tablets' friability was measured using a Roche friabilator. This gadget forces the tablets to abrasions and shock in a plastic chamber rotating at 25 rpm, lowering them from a height of 6 inches with each rotation. A sample of tablets that had been preweighed was placed in the friabilator and exposed to 100 revolutions. Tablets were reweighed after being dusted with a light muslin towel.

The friability (F %) is given by the formula

$$\mathbf{F\% = W_{0\,/}\, W \times 100}$$

Where,

F% = Friability in percentage

W_0 = Initial weight of the tablets before the test

W = weight of the tablets after the test

Weight variation:
20 tablets remain randomly designated, the average weight stood ascertained, and then they remain weighed individually to calculate the standard deviation.

Drug content:
Twenty tablets remain upright and crushed. A quantity of powder equal to the amount of a single tablet (50 mg) was accurately weighed and transferred to a 100ml volumetric flask. A 100ml volumetric flask was filled to the brim with methanol, which was then sonicated for 10–15 minutes. By UV spectroscopy at a wavelength of 425 nm for Curcumin and 272nm for Bicalutamide, the drug content remains invincible [20].

In vitro disintegration test for immediate release Curcumin tablets
Six pills were arbitrarily selected from each lot for disintegration testing. The disc disintegration test was conducted without the disc in simulated stomach fluid (37 ± 0.50°C) utilizing a disc disintegration equipment.

In vitro dissolution studies [22]

Immediate release Curcumin tablets
It stood conceded on type II equipment with the paddle exhausted. 500 ml of pH 1.2 buffer (0.1N HCl) was utilised as the dissolving media at 37 ± 0.5 °C and 50 rpm. The illustrations are evaluated using a UV spectrophotometer at 425 nm for a predetermined time interval of up to 40 minutes while remaining opaque.

Controlled-release tablets of Bicalutamide
It stays granted for type II equipment utilizing the paddle. 900 cc of pH 1.2 buffer (0.1N HCl) was utilised as the dissolving media at 37 ± 0.5 °C and 50 rpm. The material was examined using a UV spectrophotometer at a wavelength of 272 nm after a 24-hour period of inactivity.

Bi-layer tablet of Curcumin and Bicalutamide
The bilayer pills continue to be dissolved using type II equipment using a paddle. 900 cc of pH 1.2 buffer (0.1N HCl) was used as the dissolving media at 37 ± 0.50C and 50 rpm. The material was analyzed on a UV spectrophotometer using the simultaneous estimation method [23] while inverted for a duration of up to 12 hours.

Statistical analysis of responses
The Surface response plot, Contour plots were drawn using Design Expert Software v 8.0.6.1 (STATEASE).

Stability studies
Using a Thermo lab TH 90S stability chamber and maintaining a temperature of 40 ± 2 °C and a relative humidity of 75 ± 5% for three months in accordance with the ICH's requirements, the increased preparation's stability was assessed. The drug content, floating behaviour, and in vitro drug release profile of the product continue under observation [25].

RESULT AND DISCUSSION:

Compatibility studies of drug and polymers

Fourier transform infrared spectrometry (FTIR)
As shown in **Figure 1,** there was no evidence of a probable interaction between Curcumin and super disintegrant in their pure or mixed forms. As shown in **Figure 2,** there was no evidence of a probable interaction between Bicalutamide and disintegrant in their original or mixed forms.

Differential Scanning Calorimetry (DSC)
Using DSC, which is a qualitative analytic tool for evaluating interactions, compatibility examinations were similarly conceded. As shown in **Figure 3,** the thermogram suggested that there was no significant change in the endothermic peaks of curcumin in mixed samples. Using DSC, which is a qualitative analytic tool for evaluating interactions, compatibility examinations were similarly conceded. **Figure 4** of the thermogram reveals that the Bicalutamide endotherm peaks in combination samples did not alter significantly.

Preparation and optimization of bilayer tablets
In recent years, proponents of a bilayer drug release technique using CCM and BCT have worked to increase the medication's bioavailability and pharmacokinetic properties by extending the time it spends in the stomach. Oral dissolving tests must be carried out before bilayer tablet production can start in order to fully understand how this technology operates in practice. Preformulation testing is now being done on the sodium starch glycolate super disintegrant to evaluate how it interacts with the HPMC-K100 hydrophilic matrix and instant release layer. The bilayer pill was created using the optimized formulations N-2 from the immediate-release layer and NA-4 from the floating layer. With the use of the direct compression process, each formulation was produced. The fact that all formulations were

produced within the parameters of the physicochemical evaluation suggests that this method was regarded effective.

Characterization parameters

Characterization parameters for immediate release tablets of Curcumin

The prepared tablet has a thickness between 3.675 ± 0.94 and 2.653 ± 0.45 mm. The established range for the tablet's hardness is between 3.1 and 3.9 kg/cm2. As shown in **Table 3,** the friability of all tablets continues to be less than 1%, or in the range of 0.231%–0.426%. Due to its expanding tendency upon wetting, the N-3 formulation has the shortest disintegration time at 12.51 seconds.

Characterization parameters for floating tablets of BCT

The produced tablet maintains a thickness between 3.214 ± 0.63 and 3.845 ± 0.62 mm. The GRDDS formulation of bicalutamide maintains a hardness in the range of 5.1–5.8 kg/cm2. As shown in **Table 4,** the friability of complete tablets continues to be less than 1%, or in the range of 0.205%–0.419%.

In vitro dissolution studies

Comparison was made between the dissolution profiles of preparations containing both disintegrant. Therefore, formulation N-2 containing Xanthan gum at a concentration of 25% is classified as the optimal formulation because it disintegrates very rapidly in 12.51 seconds and releases more than 99 percent of the medication in 45 minutes, as shown in **Table 4** and **Figure 5.** Thus, batch N-2 of a layer with immediate release. According to **Table 5,** the formulation NA-4 with the highest gas-forming agent concentration and the lowest HPMC K4M concentration exhibited the greatest drug release. These release changes revealed that the necessity of release remained in place. NA-2>NA-5>NA-1>NA-3>NA-4. For bilayer tablets Bilayer floating tablet composition includes an immediate-release layer (N-2 Batch) and a controlled-release floating layer (NA-4 Batch). It has been determined that the average weight, thickness, and hardness of primed tablets are 400 mg, 4.82 mm, and 5.1 kg/cm2 respectively. The In vitro drug release of the primed bilayer tablets continues to be 99.12% (Curcumin for 45 Min) and 100.16 % (Curcumin for 60 Min) (Bicalutamide in 24 Hrs.).

Stability studies

Three-month stability testing was conducted on an improved bilayer tablet formulation at 40 ± 10C and 75% RH. The drawings continue to be evaluated for modifications to their hardness, percent drug content, and in-vitro drug release. The outcomes are presented in **Table 7**. There was no discernible variation in the beyond parameters.

DISCUSSION

Long-acting Curcumin and bicalutamide are still being produced in fixed-dose combinations that can be taken orally. This can still be attained by figuring out how to prolong the drug's stay in the stomach. The same pills are still being produced with the intention of increasing bioavailability, decreasing the number of individuals who do not take enough of the drug, and thereby decreasing first-pass metabolism. An effective combination for treating prostate cancer is bicalutamide and curcumin. It has been shown that the body has a hard time absorbing curcumin. Any detection of curcumin outside the intestines, if possible at all, is meaningless. This has been the finding of a great deal of study. The half-life of bicalutamide is between seven and ten days since it is metabolized in the liver. The hope was that patients would be more likely to follow their treatment plans and get their blood pressure checked regularly if this fixed-dose combination was on a bilayer tablet. Multiple adjustments were made to the tablet's bilayer and fast release layers to achieve optimal performance. Sodium starch glycolate worked wonderfully as a disintegrant. A gelling agent was added to microcrystalline cellulose to form a matrix. Taking Crospovidone increases buoyancy, thus your things will float higher than usual. As well as sodium starch glycolate, other ingredients included lactose monohydrate, magnesium stearate, polyvinyl pyrrolidone, and talc. No interfaces can be seen between the active component, polymers, and excipients, as shown by the FTIR and DSC thermogram. To investigate the chemical and physical distinctions between the drug and the polymer, FTIR spectrum spectroscopy was used. The fact that the main peaks of curcumin and bicalutamide could be picked out indicated that there was no interference between the different functional groups. Their chemical compatibility was a plus. Similarly, DSC, a qualitative method for analyzing interactions, was used to evaluate the efficiency of the collaboration between the two systems. Based on the thermogram, it appears that the drug endotherm peaks in the pure drug sample and the combined sample are the same. Because of their high water absorption, the samples may have changed shape and the mixture's peak may have moved. Although it is more costly and time-consuming than alternative methods, direct compression is nevertheless widely used in the tablet manufacturing process. Research is needed to characterise the manufactured sustained release tablet, rapid release tablet, and bilayer tablet for their hardness, weight change, thickness, homogeneity of drug content, in vitro disintegration time, and in vitro dissolution. Floating tablets, quick release tablets, and bilayer tablets were all crushed using a RIMEK I multi-station rotary punching machine with circular flat-faced

punches of 9.5 mm, 4 mm, and 9.5 mm. Additional research into the floating property confirmed that all of the in question formulations floated as well as or better than expected. Due to the gel layers formed by the examined polymers, all formulations were able to function for more than twenty-four hours. Increases in HPMC-K100 concentration are associated with increases in floating lag time due to the possibility that the tablet matrix is more difficult to reach at higher concentrations. N-2 and NA-4 were found to be the best components for a bilayer tablet after an in vitro release revision and stability study was performed. A number of variables were taken into account to arrive at this conclusion. Values generated by the optimized bilayer tablet were almost often well within the allowable range.

Table 1: Formula for the preparation of Curcumin Granules

Sr. No.	Ingredients	N-1 (mg)	N-2 (mg)	N-3 (mg)
1	Curcumin	100	**100**	100
2	Xanthan gum	55	**50**	45
3	Sodium starch glycolate	16	**16**	16
4	Dicalcium phosphate	24	**24**	24
5	Microcrystalline cellulose	55	**60**	65
	Total weight	250	**250**	250

Table 2: Formula for the preparation of Sustained Release Bicalutamide solid dispersions Tablets

Sr. No.	Ingredients	NA-1 (mg)	NA-2 (mg)	NA-3 (mg)	NA-4 (mg)	NA-5 (mg)
1	Bicalutamide	50	50	50	**50**	50
2	Lactose monohydrate	60.30	70.30	65.30	**65.30**	65.30
3	Sodium starch glycolate	20.80	10.80	20.80	**15.80**	10.80
4	Polyvinyl pyrolidone	2.40	2.40	2.40	**2.40**	2.40
5	Purified water	q.s.	q.s.	q.s.	**q.s.**	q.s.
6	Magnesium stearate	1.5	1.5	1.5	**1.5**	1.5
7	Crospovidone	15	15	10	**15**	20
	Total Weight	**150**	**150**	**150**	**150**	**150**

Table 3: Evaluation of Immediate Release Cucumin Tablets

Formulation	Thickness± S.D. (mm) (n = 10)	Hardness ± S.D.(kg/cm2) (n = 5)	Friability (%) (n = 10)	Avg. weight variation (n = 20)	Drug content (%)	Disintegration time (in sec) (n = 6)
N-1	3.675 ± 0.94	3.1± 0.5	0.602± 0.4	249.76 ± 1.52	98.33	10.43± 0.95
N-2	2.321 ± 0.32	3.8± 0.6	0.452± 0.1	252.87 ± 0.87	97.09	11.32± 1.12
N-3	**2.653 ± 0.45**	**3.2± 0.9**	**0.542± 0.3**	**251.96 ± 1.76**	**99.59**	**12.51± 1.54**

Table 4: Evaluation of Sustained Release bicalutamide Tablets

Formulation	Thickness± S.D. (mm) (n = 10)	Hardness ± S.D.(kg/cm2) (n = 5)	Friability (%) (n = 10)	Avg. weight variation (n = 20)	Drug content (%)
NA-1	3.214 ± 0.63	5.1± 0.2	0.281± 0.3	149.76 ± 1.42	97.93
NA-2	3.765 ± 0.36	5.8± 0.5	0.214± 0.4	152.87 ± 1.41	99.31
NA-3	3.845 ± 0.62	5.2± 0.1	0.251± 0.2	151.96 ± 0.72	98.32
NA-4	**3.424 ± 0.48**	**5.3± 0.6**	**0.192± 0.2**	**151.96 ± 0.41**	**100.2**
NA-5	3.631 ± 0.93	5.4± 0.2	0.201± 0.8	152.87 ± 0.21	99.31

Table 5: In vitro drug release study for Curcumin immediate-release tablets

Time (Minutes)	N-1	N-2	N-3
3	38.54	**42.54**	57.61
5	44.54	**46.32**	61.26
10	48.23	**52.56**	65.62
15	55.89	**59.87**	72.36
20	64.17	**73.21**	82.85
25	69.98	**79.34**	87.41
30	76.42	**84.21**	93.53
35	83.65	**87.76**	97.27
40	88.45	**93.56**	100.54
45	94.56	**98.87**	100.21

Table 6: In vitro drug release study for Bicalutamide Sustained-release tablets

Time (Minutes)	NA-1	NA-2	NA-3	NA-4	NA-5
0.5	12.15	10.41	16.90	**18.55**	12.09
1	18.753	13.89	25.89	**26.99**	17.96
2	27.91	17.83	34.69	**35.42**	24.00
4	35.784	21.73	42.38	**43.11**	29.68
8	50.984	32.94	62.70	**61.61**	49.46
10	62.887	45.94	72.78	**73.51**	63.19
12	70.392	52.35	78.09	**78.09**	68.69
16	75.341	59.86	82.67	**86.33**	73.45
20	83.215	64.44	87.61	**92.00**	77.84
24	88.159	68.83	92.00	**97.32**	81.87

Table 7: Stability Data for optimized bilayer tablet formulation

Time (Month)	Evaluation parameters				
	Hardness (kg/cm2)	Drug content (%)		In-vitro drug release	
		Curcumin	Bicalutamide	Curcumin	Bicalutamide
0	5.1	99.56	99.81	99.12	100.16
1	5.0	99.54	99.71	100.01	99.56
2	5.0	99.31	99.67	99.76	99.81
3	4.9	98.81	99.01	99.23	100.02

Figure 1 FTIR spectra of Curcumin and Curcumin along with all excipients

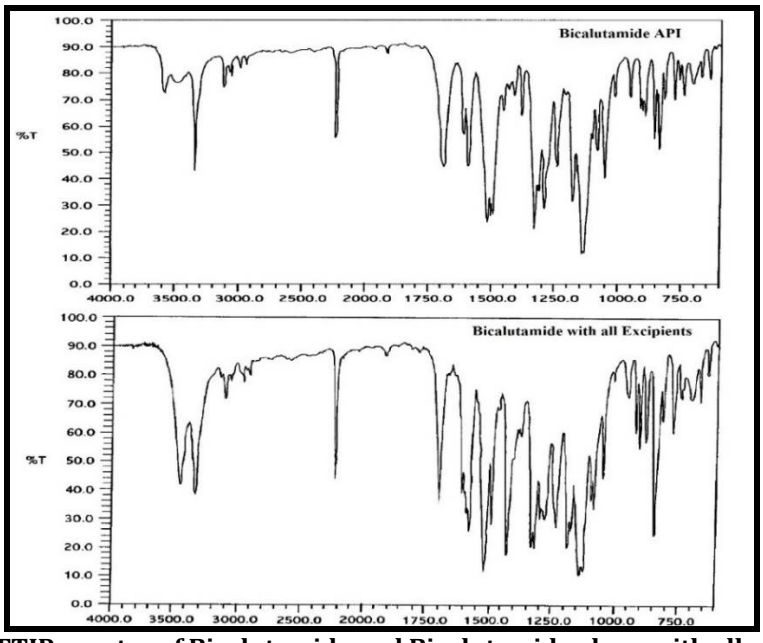

Figure 2 FTIR spectra of Bicalutamide and Bicalutamide along with all excipients

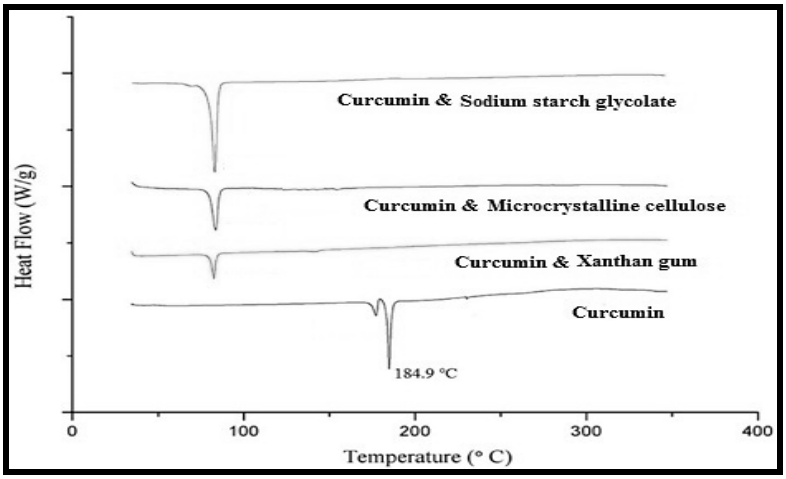

Figure 3: DSC thermogram of Curcumin and Curcumin along with excipients

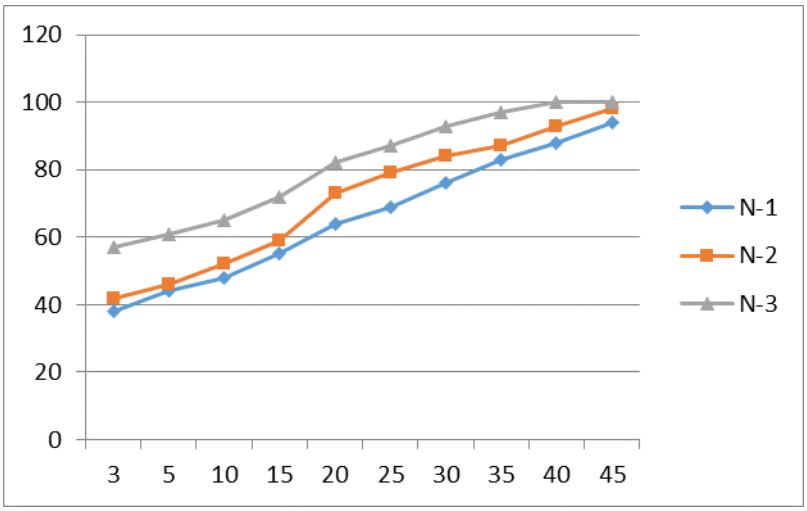

Figure 4: In vitro drug release study for Curcumin tablets

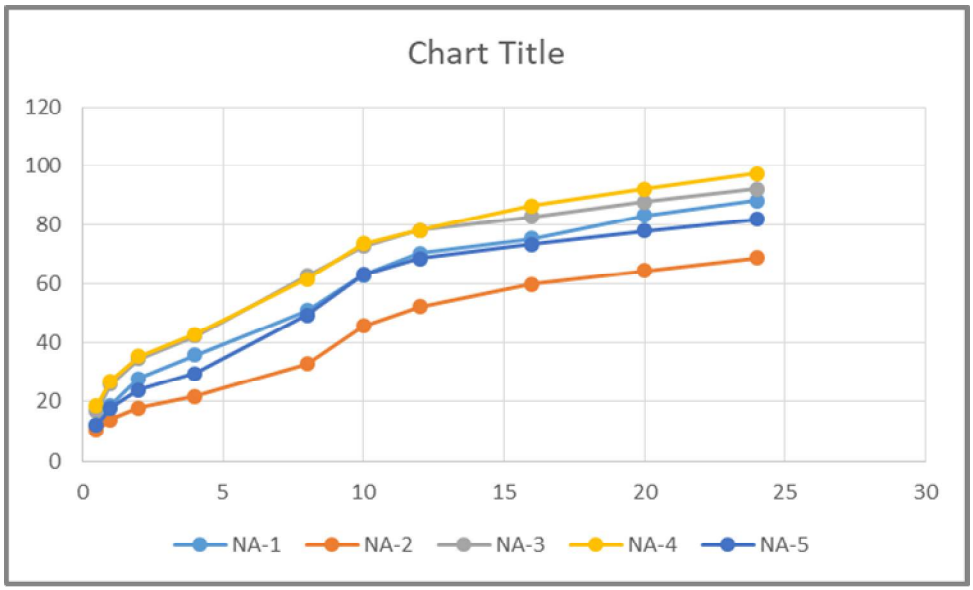

Figure 5: In vitro drug release study for Bicalutamide tablets

CONCLUSION

It was decided to make a tablet with two layers. The first layer was designed to quickly release the curcumin, while the second layer was made to slowly release the bicalutamide. Before and after compression, the tablet retains its superior qualities. An established practice is to divide the total dosage into two parts and release them at separate times. This technique was created due to the pharmacokinetics and therapeutic needs of the medicine. Sodium starch glycolate plays a crucial role in the immediate release layer by accelerating the drug's metabolism and elimination from the body. Since curcumin and bicalutamide can be taken at different times, our research suggests that bilayer pills containing both drugs may be an efficient way to treat migraines. Based on the evidence, it was established that two treatments of varying doses could be administered in a way that improved bioavailability, patient compliance, and sickness monitoring if the medicine were manufactured in a systematic way.

Declaration of competing interest

The authors declare no conflict of interest pertaining to this manuscript.

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