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Formulation and Evaluation of Theophylline Sustained Release Tablet using Lasianthera *africana* gum

*Akpabio, E.I., Ekong, U.S., Uwah, T.O. ,Ekpa, E.D., Ubulom, P.M.E., Jacobs, G.E. and Fred, M.E.

Department of Pharmaceutics and Pharmaceutical Technology University of Uyo, Akwa Ibom State, Nigeria.

ABSTRACT

The aim of this study was to evaluate the potential of *Lasianthera africana* gum as sustained release matrix for the formulation of theophylline tablet and the effect of this polymer on the physical properties and drug release from the tablets. The polymer was used alone and in binary combination with Guar gum at the concentration level of 20% $^{w}/_{w}$. The theophylline granules were prepared by the wet granulation method. The micromeritic and flow properties of the prepared granules such as bulk density (BD), tapped density (TD), flow rate, Carr's compressibility index (CI), Hausner's quotient (HQ) as well as angle of repose (AR) were evaluated using standard methods. The compressed tablets were assessed for weight uniformity, crushing strength, friability, thickness, diameter and uniformity of content. The dissolution profile of the theophylline sustained release tablets was assessed in simulated gastric fluid without the enzyme for a period of 8 h at an agitation rate of 50 rpm and a temperature of 37 ±0.5ºC. Drug release was analyzed spectrophotometrically at wavelength of 271nm using (UNICO-spectrophotometer, UV-2100PC Shanghai Instrument Co., Ltd., China). In order to investigate the release kinetics the data obtained from the *in vitro* dissolution studies were fitted into various kinetic models which include Zero order, First order and Higuchi. The mechanism of release was further ascertained by fitting the data of the drug release into the Korsemeyer-Peppas equation. The bulk density, tapped density, flow rate, Carr's index, Hausner's ratio and angle of repose ranged from 0.37 g/cm^3 to 0.40 g/cm^3, 0.53 to 0. 58 g/cm^3, 4.65 to 6.90 g/s, 25.3 to 33.9 %, 1.35 to 1.52, 33.6^0 to 42.7^0, respectively. The crushing strength ranged from 5.83 kg/f to 7.07 kg/f, friability ranged from 0.768 % to 0.910 %, diameter for all the batches was uniform (12.51mm), thickness ranged from 2.48 mm to 2.51 mm, while values for content uniformity ranged from 99.17 % to 99.26 %. The two gums sustained the release of theophylline up to 8 h. The release of theophylline followed zero order kinetics via non-Fickian transport.

KEY WORDS: Sustained release, *Lasianthera africana*, Guar gum, theophylline tablets.

INTRODUCTION

In Nigeria today, there is an over dependence on expensive imported pharmaceutical raw materials leading to a depletion of our foreign reserves and increase in the cost of production. These result in a concomitant increase in the price of the finished products. Currently about 80 % of the raw materials used in the pharmaceutical industries in Nigeria are imported (Ogbuagu, 2004). There is therefore the need to source for and fully utilize the locally available raw materials which nature has endowed us with. The use of naturally occurring hydrophilic biocompatible polymeric materials have been the focus in recent research activities in the design of oral controlled release dosage forms (Patel et.al. 2012). Natural gums are among the most popular hydrophilic polymers because of their cost effectiveness and regulatory acceptance (Varshosazi et. al., 2006). The use of naturally occurring plant based pharmaceutical excipients has become very important in the development of control released dosage forms, because of their ability to produce a wide range of material based on their properties and molecular weight (Ngwuluka et.al., 2010). Plant based materials can be modified to meet the requirements of drug delivery systems and thus can compete with the synthetic excipients available in the market (Prabhaharan, 2011). Natural gums are polysaccharides capable of causing a large increase in a solution's viscosity, even at small concentrations.

Lasianthera africana (P. Beav.), known as Editanin the Ibibio dialect is a perennial glabrous shrub of the family*Icacinaceae*whose height may reach from 61cm to 136cm and is widely distributed in the tropical rain forest (Hutchinson and Dalziel, 1973). There are four ethno varieties distinguished by their taste, leaf colour and ecological distribution. The leaves are majorly consumed as vegetable in southern Nigeria. Ethnobotanically, *L. africana*is used as antacid, antispasmodic, laxative, analgesic, antipyretic, antiulcerogenic, antidiabetic and antimalarial (Okokon et.al., 2007).

*Corresponding author. Email: pharmeka2000@yahoo.com Phone: +2348027302734

However, there is no documented report on the use of Lasienthera gum as a pharmaceutical excipient. Oral sustained release drug delivery system can release their drug content in a controlled manner producing a desirable blood serum level, reducing drug toxicity and improving patient compliance by prolonging dosing interval (Ankit et. al., 2013). The oral route is the most common route of drug administration because of its advantages in terms of convenient administration, thus leading to increased patient compliance. Extended release formulations in many cases provide further significant advantages, including improved therapeutic effect, increased patient compliance by reducing dosing frequency and decrease in incidence and/or intensity of adverse effect by a constant blood concentration (Nokhodchi et. al., 2012). Theophylline is a methylxanthine derivative which is very effective in the chronic treatment of bronchial asthma and bronchospastic reaction. It has a biological half-life of 3-4 hours and its therapeutic concentration range is narrow (from 10 to 20µg/mL) while toxicity usually appears at concentration above 20 µg/mL. The fluctuations of its serum concentrations can result in variability in clinical response (Ellis, 2004). Therefore, there is an obvious need for sustained release dosage form which will be able to maintain therapeutic serum levels of theophylline throughout 24hours using once or twice administered dose daily (Prabaharan,2011). The objective of the study is to assess the performance of the gum extract from *Lasianthera africana* leaves as a sustained release matrix for theophylline tablets and also to assess the *in vitro* sustained release properties of the dosage form.

MATERIALS AND METHODS

Theophylline anhydrous(Sigma, -Aldrich, UK) ,Guar gum (Sigma, -Aldrich, UK) , Ethanol, magnesium stearate, talc (BDH Chemicals Poole, England) *Lasianthera africana* leaves were procured from UrukUso village in Abak ,AkwaIbom State. Acetone, Microcrystalline cellulose (BDH Chemicals,Ltd.,Poole England)

Methods

Extraction of *Lasianthera africana* Gum

Fresh leaves of *Lasianthera africana* were cleaned, crushed and then macerated in distilled water for 30 minutes with intermittent stirring. The mucilage was filtered through a white muslin cloth to extract the gum; acetone was added to precipitate the extracted gum. The gum was then filtered under vacuum to remove acetone and dried in a desiccator (Samsam, 1992).

The physicochemical properties of *Lasianthera* gum such as;pH , swelling index and water absorption capacity were determined using standard methods (Iqbal and Hussian, 2010). The organoleptic properties of the gum were also determined.

pH of Lasianthera gum

The pH of Lasianthera gum was determined by shaking various concentrations 0.1, 0.2, 0.5and 1%w/v dispersion of the gum in water and the pH determined using a pH meter (Philips D2S-706, Amsterdam). The pH determinations were made in triplicate and the mean pH value calculated.

Swelling index of Lasianthera gum

The swelling index of LG was determined using the modified method of Gauthami and Bhat (Gauthani and Bhat, 1929). A 1 g quantity of LG was accurately weighed and transferred to a 100 mL stoppered measuring cylinder. The initial volume occupied by the gum powder was noted and the volume was made up to 100 mL with distilled water. The cylinder was stoppered, shaken and set aside for 24 h. The volume occupied by the gum sediment was noted after 24 h. Swelling index (SI) is expressed in percentage and was calculated using Equation 1:

$SI\ (\%) = (V_t\text{-}V_o/V_o)\ 100$……..……1

Where $V_o$is the initial volume of the powder in a graduated cylinder and V_t denotes the volume occupied by the swollen gum after 24 h.

Water absorption capacity

The content of the measuring cylinder used for the swelling index test was filtered through a muslin cloth and the water allowed to drain completely into a dry 100 mL measuring cylinder. The volume of water collected was noted and the difference between the original volume of the mucilage and volume drained was taken as the water retained by the gum and is reffered to as water absorption capacity.

Formulation of theophylline sustained release tablets.

The composition of theophylline sustained release tablets are shown in Table 1.

Preparation of Theophylline Granules

The granules were prepared using the wet granulation method (Rajalakshmi et.al, 2011). The ingredients were weighed accurately and mixed in a glass mortar.

Granulation was done with a solution of either Guar gum alone, Lasianthera gum alone or a binary combination of Guar gum and Lasianthera gum in 95 % alcohol.

Table1: Composition of Theophylline Sustained Release Tablet

Ingredients per tablet	Batch1	Batch2	Batch3
Theophylline(mg)	200	200	200
Lasianthera gum(%w/w)	20	_	_
Guar gum(%w/w)	_	20	_
Lasianthera gum and Guar gum 1:1	_	_	20
Magnesium stearate (%w/w)	1	1	1
Talc (%w/w)	1	1	1
Microcrystalline cellulose qs (mg)	400	400	400

KEY: Batch1: Theophylline + 20%$^{w}/_{w}$ Lasianthera gum. Batch2: Theophylline + 20%$^{w}/_{w}$ Guar gum. Batch3: Theophylline + 20%$^{w}/_{w}$ Lasianthera gum and Guar gum (1:1)

The wet masses were passed through a 2 mm sieve and the resultant granules were dried in a conventional hot air oven (P.Selecta,Spain) at 40º C for 2 h. The dried granules were then passed through a 1 mm sieve and stored for futher experiments. Three batches of granules were prepared.

Evaluation of theophylline Granules

Flow rate

The flow rate of the granules was determined by recording the time taken for 30g of granules from each batch to flow through a funnel orifice, suspended in a retort stand at a height of 7.5 cm from the horizontal surface (Stanifort, 2004).

Angle of repose

The fixed funnel method was used. An accurately weighed quantity of granules was taken in a funnel. The height of the funnel was adjusted in such a way that the tip of the funnel just touched the apex of the granules. The granules were allowed to flow through the funnel freely on to the surface. The diameter of the cone was measured and the angle of repose was calculatedusing Equation 2 below:

$$\tan\theta = h/r \quad \text{----------2}$$

Where
h= height of granule heap
r= radius of base of the powder

Density determination

Bulk density

A 30g quantity of the granules was weighed and transferred into a 100mL graduated cylinder. The initial volume Vo was noted. And the bulk density was calculated using Equation 3:

$$BD = W/V_o \quad \text{---------- 3}$$

Where BD is bulk density, W is weight of granule and V_o is bulk volume

Tapped density

A 30 g quantity of the granules which was previously placed in the 100 mL graduated cylinder as described above was mechanically tapped by raising the cylinder and allowing it to drop under its own weight. The cylinder was tapped up to 100 times until no further reduction in volume was noted. The tapped bulk density was then calculated using Equation 4:

$$\text{Tapped density (TD)} = \frac{\text{Weight of powder}}{\text{Tapped volume}} \quad \text{---------- 4}$$

Hausner's ratio: This was calculated as the ratio of the tapped density to the bulk density for each batch of granules (Hausner, 1967).

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}} \quad \text{----------5}$$

Carr's compressibility index: This was calculated by using Equation 6 below:

$$\text{Carr's index} = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}} \times 100 \quad \text{----------6}$$

Compression of theophylline tablets.

Prepared granules were lubricated with 1 % magnesium stearate and 1 % talc, and compressed into tablets using a single punch tableting press fitted with 12.5 mm flat faced punches (Cadmach, Ahmedabad, India) at a constant compression pressure of 25KN.

Evaluationof the physical properties of theophylline tablets

Weight uniformity test

Twenty (20) tablets of each formulation were weighed using an electronic balance (OHAUS, Galaxy).The mean, standard deviation and coefficient of variation were calculated.

Crushingstrength
The crushing strength of the tablets was determined using the Monsanto hardness tester (Rolex, Chandigarh). Ten tablets from each batch were tested (Eric,2013).

Friability
The friability (F) of 10 tablets was measured in a Roche friabilator (UNID 056830 Campbell Electronic, Mumbai,India). The tablets were dedusted and weighed (W_o) and then placed in the friabilator, which was rotated for 4 min at 25rpm. Then the tablets were removed from the chamber dedusted and reweighed (W_1). The friability was then calculated using Equation 7:

$$F = \frac{(W_O - W_1) \times 100}{W_1} \text{ ---------- 7}$$

Where W_o is the initial weight of tablets,W_1 is the final weight of tablets.

Thickness
The thickness of 10 tablets was determined using a micrometer screw gauge (KFW Scientific Industries Ambala Cantt, India). Triplicates determinations were made.

Diameter
The diameter of 10 tablets from each batch was determined using micrometer screw gauge (KFW Scientific Industries AmbalaCantt, India).The determinations were carried out in triplicates.

***In vitro* drug release study of theophylline sustained release tablets.**
Drug release study was carried out according to USP 23 basket method. The dissolution studies were conducted with Erweka dissolution apparatus (DD-DT). The dissolution media was 500 ml of simulated gastric fluid pH (1.3) maintained at a temperature of 36 $\pm 0.5^0$C. The agitation of the medium was maintained at 50rpm. Ten millilitres (10 ml) samples were withdrawn up to 8 hours at 30 minutes intervals, and replaced with an equivalent 10 ml of the dissolution medium maintained at the same temperature. The withdrawn samples were analyzed spectrophotometrically at a wavelength of 271 nm using (UNICO – Spectrophotometer, UV-2100PC Shanghai instrument Co. Ltd., China) and cumulative percentage drug release was calculated. The study was performed in triplicate.

***Invitro* kinetic models of theophylline SR matrix tablets**
In order to investigate the drug release kinetics, the data obtained from *in-vitro* dissolution studies were plotted into various kinetic models, which include first order, Higuchi and Hixson- Crowell (Pash et. al., 2010).

Mechanism of drug release from theophylline SR matrix tablets.
The mechanism of drug release was determined by plotting 50-80% drug release fitted intoKorsemeyer- Peppas model equation. (Korsemeyer et. al.,1983

Standard calibration curve of theophylline in simulated gastric fliud (SGF A 50mg quantity of theophylline (anhydrous) was dissolved in 30 mL of (SGF). The resultant solution was transferred to a 50mL volumetric flask and made up to volume with SGF. Serial dilutions of 0.02 µg, 0.04 µg, 0.06 µg, 0.08 µg, 0.10 µg, 0.12 µg, 0.14 µg and 0.16 µg/mL were prepared, and theirabsorbances were read in a UV- spectrophotometer (UNICO-Spectrophotometer, UV-2100 PC, Shanghai instrument Co., China) at a wavelength of 271 nm. Graphs of absorbance versus concentration were plotted to obtain the calibration curve of theophylline (Lin et. al., 1989).

Statistical analysis
All experiments were carried out in triplicates and the results expressed as mean ±SD. The data obtained were subjected to analysis of variance (ANOVA). Differences among means were determined using the DuncanPost Hoc test.

RESULTS

Physicochemical properties of Lasianthera gum
The organoleptic properties of Lasianthera gum were assessed, and the quality was found to be good as it possessed the following properties: a smooth texture, greenish brown colour, characteristic odour and tasteless to the tongue. When introduced into cold water, Lasianthera gum was observed to swell and absorbed water, an indication that it may be a good candidate for sustained release dosage forms. The pH of the gum was 6.4.

Percentage yield of Lasianthera Gum
The percentage yield of the gum was calculated using Equation 8:

$$\text{percentage yield of Lasianthera gum} = \frac{\text{weight of gum}}{\text{Weight of ground leaves}} \text{x100}$$

$$= \frac{130g}{3500g} \text{X } 100 = 3.7\%$$

Swelling index and water absorption capacity of Lasianthera gum
The swelling index of the gum was 80 %.while the water absorption capacity of the gum was 16.3 ml. The swelling ability of any natural gum depends upon the water absorption capacity.

Micromeritic and flow properties of theophylline granules
The result of bulk density (BD), tapped density (TD), Hausner's ratio (HR), Carr's index (CI), angle of repose (AR), and flow rate (FR) are presented in Table 2.

Granules properties

From the study the bulk and tapped density ranged from 0.37g/cm^3 to 0.40g/cm^3 and 0.53 to 0.58g/cm^{3}respectively. Batch2 possessed the least bulk density, followed by Batch1, while Batch3 exhibited the highest bulk density. For the tapped density, Batch1 possessed the least tapped density, followed by Batch 2 and Batch3 exhibiting the highest tapped density. Bulk density is an important physical property in the characterization, handling, processing of the powder system. The bulk density of a powder depends on its particle size distribution, the mass of the powder used and the method of determination (Stanifort,2002) Since all the batches possessed uniform particle sizes, same mass of granules used for the test and same method applied, the differences in bulk and tapped density between the batches could be due to the nature of polymers used in the different batches.

The Hausner's ratio and Carr's compressibility index are both indirect measures of the flow properties of powder. From the results obtained, the Carr's index was between 25.3% to 33.9%, an indication of a flow property between passable to very poor (Carr, 1965). Batch 1 possessed passable flow, Batch2 possessed very poor flow, and Batch3 possessed poor flow. The Hausner's ratio was between 1.35 to 1.52, indicating a flow property rated poor to very poor. Batch1 possessed poor flow, Batch 2 and Batch3 showed very poor flow. The difference in flow properties could be attributed to the nature of the polymers used and its cohesiveness. The smaller the value of Carr's index and Hausner's ratio the better the flow properties of powder.

The results of flow rate ranged from 4.85 g/s to 6.90 g/s. These values indicate fair flow characteristics, with Batch1 possessing a flow rate of 4.65 g/s, Batch2, 5.67 g/s and Batch3 with a flow rate of 6.90 g/s.

Angle of repose

This is an important macroscopic parameter in characterizing granular materials. The values obtained from the study was between 33.6^0 to 42.7^0, indicating flow properties rated good to passable, Batch 1 possessed good flow, Batch 2 possessed passable flow and Batch 3, a fair flow.

Physical properties of tablets

Weight uniformity

Weight uniformity is an in process test parameter which ensures consistency of dosage units during compression. From the results of the study, the weight of the tablets ranged from 0.410mg to 0.414mg, indicating that there was no significant difference in the weight of all the tablets in the batches. The variation expressed by the different batches indicate uniformity to the standard requirement as stipulated by the British Pharmacopoeia, which states that for tablets weighing greater than or equal to 250mg, not more than 2 tablets should differ from the average weight by more than 5% and none deviates by more than twice that percent (BP, 2008).

Tablet hardness From the study the hardness values ranged from 5.83kg/f to 7.05kg/f. Tablet hardness typically affects disintegration, dissolution, release and bioavailability of the drug (Qureshi et al., 2014).

Conventional tablet hardness ranges from 5 to 10kg/f (USP, 2007). Based on the results, all the batches were within the stated United State Pharmacopoeia range, with Batch1 possessing the highest value of 7.05 kg/f, followed by Batch2 with hardness value of 6.99kg/f and Batch3 having a value of 5.83kg/f. Hardness always influence the compaction of substances in the tablets, the higher the hardness, the higher the compaction. A higher compaction causes a decrease in porosity of the polymer matrix, and tablets with high compaction values, have the ability to retard solvent penetration into their core (Kiattisak et al., 2007).

Tablet thickness ranged from 2.48mm to 2.51mm with diameter of 12.51mm for all the batches. These parameters influence the weight uniformity of the tablets and consequently dose uniformity. From the study, values obtained were fairly consistent and within the range of pharmacopoeial standard (BP, 2008). This showed that the tablets would yield uniform weights and dose.

Tablet friability

The percentage friability obtained ranged from 0.77% to 0.91%. The test of friability measures the ability of the tablet to withstand abrasion during packing, handling and shipping. The normal limit for friability is less than or equal to 1% (BP, 2008). From the results of the study, the values obtained were less than 1% in all the batches.

Drug content

The results of drug contents were 99.17%, 99.26% and 99.19% respectively for Batches 1, 2 and 3. All the results were within official limits (USP28, 2004), showing proper mixing and processing of the batches.

***In vitro* release studies**

The result of the *in vitro* release studies of the different batches of theophylline sustained release tablets showed that Batch 1 formulated with Lasianthera gum possessed a maximum percentage release of 92.38% at 8h, Batch 2. formulated with Guar gum alone was the least effective of all the polymers under study in sustaining the release of the drug. This could be due to the viscosity of the gum as the viscosity

Table 2: Micromeritic and flow properties of theophylline granules

Formulations	Bulk Density (g/cm^3) Mean± SD	Tapped Density (g/cm^3) Mean± SD	Carr's Index (%) Mean ± SD	Hausner's Ratio Mean ± SD	Flow Rate (g/s) Mean ± SD	Angle of Repose (^{0}) Mean ± SD
Batch 1	0.39 ± 0.01	0.53 ± 0.02	25.3 ± 2.49	1.35 ± 0.05	4.65 ± 0.09	33.6 ± 1.80
Batch 2	0.37 ± 0.01	0.57 ± 0.01	33.9 ± 0.94	1.52 ± 0.02	6.90 ± 0.09	42.7 ± 0.40
Batch 3	0.40 ± 0.02	0.58 ± 0.01	31.9 ± 1.40	1.47 ± 0.02	5.67 ± 0.06	39.2 ± 1.90

KEY: Batch 1: Theophylline + 20%$^w/_w$ Lasianthera gum(LG)
Batch 2: Theophylline + 20%$^w/_w$ Guar gum (GG)
Batch 3: Theophylline + 20%$^w/_w$ Lasianthera gum+20 % w/w Guar gum

Table 3: Physical properties of theophylline sustained release tablet

Formulation	Weight variation (g) Mean ± SD n=20	Thickness (mm) Mean ± SD n=10	Diameter (mm) Mean ± SD n=10	Hardness (kg/f) Mean ± SD n=10	Friability %	Drug content %
Batch 1	0.410 ± 0.01	2.48 ± 0.06	12.51 ± 0.03	7.05 ± 1.42	0.768	99.17
Batch 2	0.414 ± 0.01	2.51 ± 0.03	12.51 ± 0.01	6.99 ± 0.49	0.833	99.26
Batch 3	0.412 ± 0.01	12.51 ± 0.03	12.51 ± 0.01	5.83 ± 0.52	0.910	99.19

KEY: Batch1: Theophylline + 20%$^w/_w$ Lasianthera gum (LM)
Batch2: Theophylline + 20%$^w/_w$ Guar gum
Batch3: Theophylline + 20%$^w/_w$ *Lasianthera* gum + Guargum(GG)

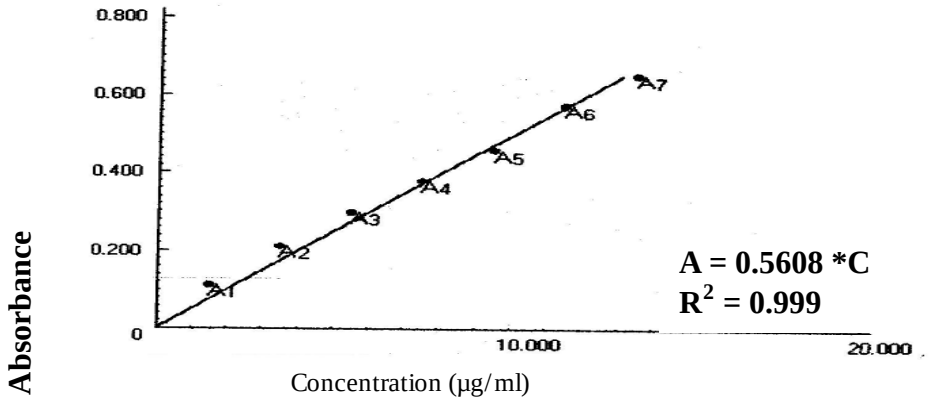

Figure 1: Theophylline Beer's plot in simulated gastric fluid

grade of guar gum affects the release of drug (Al-Saidan et. al., 2005). Batch 2 showed a maximum release of 94.05% at 8h. Batch3 formulated with a combination of Lasianthera gum and Guar gum exhibited a maximum release of 90.48%.there was a very rapid initial release of theophylline from LG and GG combination closely followed by GG alone. This observation has been reported in a previous study (Varshosazi et. al., 2006).

It was concluded that Guar gum alone could not effectively control drug release from Tramadol hydrochloride sustained release tablets. The reason behind this observation is that Guar gum has minimum water uptake and hence minimum swelling (Al-Saidan et.al., 2005). At low concentration such as was used for this study Guar gum exhibits a rapid release of drug but when its concentration in the matrix is increased, a higher initial release as well as increased drug release is observed. This is due to the low water uptake of Guar gum. It was also observed that all the batches showed a burst effect, releasing more than 30% of the drug within the first 1h, which can be attributed to surface erosion or initial disaggregation of the matrix tablets prior to gel layer formation around the tablet core (Ebube et. al., 1997). The release of the remaining drug was sustained at constant rate over 8 h.

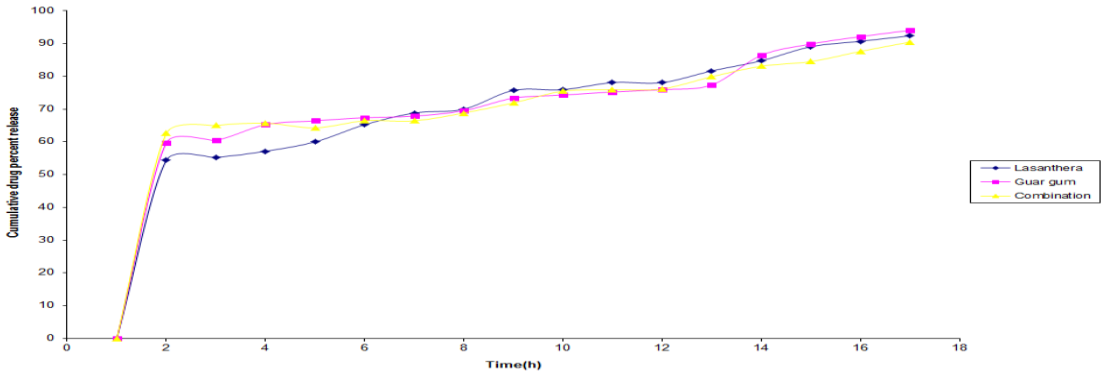

Figure 2: Release profile of theophylline sustained release tablet

Table 4: Release Kinetics of Theophylline Sustained Release Tablet

Formulations	R^2				
	Zero order	First order	Higuchi	Korsemeyer	n(diffusion exponent)
Batch 1	0.985	0.943	0.970	0.915	0.21
Batch 2	0.942	0.819	0.878	0.810	0.16
Batch 3	0.954	0.884	0.875	0.765	0.13

Thus Batch 1 containing Lasianthera gum alone exhibited a marked control of theophylline release more than the other two batches.

Release kinetics and mechanism of drug release from theophylline sustained release tablet

The release data obtained from the release profiles of tablets containing LG, GG and a binary combination of both gums were fitted into the Zero order, First order and Higuchi models to determine the kinetics of drug release. Drug release from the tablets in Batch 1 showed high linearity with regression coefficients values (R^2) for Zero order, first order and Higuchimodels as follows: 0.985, 0.943, and 0.915 which showed that drug release followed zero order kinetics. By using the Korsemeyer model, the mechanism of drug release was determined with the diffusion exponent of 0.21 which depicted a non-Fickian transport. The regression coefficients values for zero order, first order and Higuchi kinetics for Batch 2 were 0.942, 0.819, and 0.878, respectively. The zero order showed high linearity with a diffusion exponent of 0.16 indicating non-Fickian diffusion. The regression coefficients for the release of theophylline from the polymer matrix containing LG and GG binary combination lied between 0.875 to 0.954 with the best fit in zero order model. The diffusion exponent of the formulation was 0.13 indicating a non –Fickian transport. Thus drug release from all the batches was independent of the concentration remaining in the dosage form (Costa and Sousa, 2001).

CONCLUSION

This study was conducted to formulate and evaluate sustained release matrix tablet using theophylline as model drug.The matrix tablets prepared by incorporating either a single or a combination of release rate retarding materials were shown to possess variable pharmaco - technical properties ranging from good to poor.

Matrix tablets formulated with *Lasianthera* gum possessed the best pharmacotechnical properties followed by matrix tablets formulated with a combination of Lasianthera gum and Guar gum. Matrix tablets formulated with Guar gum alone possessed poor pharmaco-technical properties in terms of flow as previously reported in the literature (Krishnaiah et al., 2002). The drug release profile of all the formulations showed that all the polymers were successful in effectively sustaining the drug release from the matrix tablets . All the baches of theophylline tablets followed Zero order release kinetics with non- Fickian diffusion mechanism. Based on these results, it can be concluded that a natural gum like LG could be explored as a controlled release polymer because of as a good substitute for synthetic polymers. its efficiency, ecofriendly and economical features,

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