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Disintegration and Dissolution Studies of Plain and Soluble Brands of Aspirin Tablets Embedded in Food Bolus

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article.

Abstract

Background: The practice of embedding solid drugs such as tablets and capsules in food bolus is very common in some parts of Africa especially Nigeria. The reasons for this practice range from an attempt to alleviate the side effect of gastric irritation to masking the unpleasant taste and odour of the drugs.The effects of concomitant administration of food on the disintegration, dissolution and bioavailability of orally administered drugs are well documented. However, information on orally administered solid drugs embedded in food bolus is very scarce.

Objective: This study investigated disintegration and dissolution profiles of plain and soluble brands of aspirin tablets embedded in food bolus.

Methodology: Disintegration and dissolution tests were carried out on two different brands of commercial, uncoated, immediate release (IR) aspirin tablets (300 mg) using Erweka disintegration test apparatus (GMB, Germany) and USP dissolution apparatus 2 respectively. The two different brands were coded as P (plain aspirin tablet) and S (soluble aspirin tablet). Twenty tablets from P and S brands were randomly selected and embedded in 3 g of freshly prepared food bolus made from gelatinized cassava flour (commonly called "eba") and labelled PB (plain aspirin tablet embedded in food bolus) and SB (soluble aspirin tablet embedded in food bolus). Disintegration test and dissolution test were equally conducted on PB and SB and compared with P and S.

Results: The results indicated that both P and S passed the disintegration test for uncoated tablets, while PB and SB failed the test. Moreover, P, S and SB passed the *in vitro* dissolution test by releasing more than 80 % of the drug in 30 minutes, while PB failed the test. Embedding the tablets in food bolus significantly prolonged the disintegration time of SB and PB and also significantly affected the dissolution profile and kinetic of drug release from PB but had insignificant effect on SB. ANOVA for the dissolution parameters generated for all the samples showed that the dissolution profile of S was significantly higher ($P < 0.05$) than the rest. There was no significant difference ($P > 0.05$) between the dissolution data of SB and P while the dissolution profile of PB was significantly lower ($P < 0.05$) than that of SB and P.

Conclusion: Disintegration and dissolution of plain brand of aspirin may be significantly affected if embedded in food bolus. This may not be so for soluble brand of aspirin.

Keywords: Disintegration, Dissolution, Plain and Soluble, Aspirin tablets, Food Bolus

INTRODUCTION

Disintegration and dissolution tests are part of the comprehensive *in vitro* evaluation procedures specified for oral solid pharmaceutical dosage forms (USP, 2000). While disintegration testing has become an important quality control method in the pharmaceutical industry (Al-Gousous and Langguth, 2015), dissolution testing has emerged as a very important tool for development and approval of generic dosage forms (Guo, *et al.,* 2000; Anand, *et al.,* 2011). Both disintegration and dissolution are very relevant for oral solid drugs that are poorly water soluble, especially where dissolution is the critical factor affecting the rate of systemic absorption. Tablets containing sparingly water soluble drug will exhibit poor surface wettabilty and slow penetration of liquid into the tablet. This might prolong disintegration time and retard dissolution (Galia, *et al.,* 1999; Marais, *et al.*, 2003; De Castro, *et al.,* 2006). Disintegration and dissolution tests are important in formulation development and quality control to ensure batch to batch consistency of a product. In addition, dissolution can be used as a surrogate to evaluate drug bioavailability and address the issues of bioequivalence and interchangeability of generic and branded products (USP, 2000; Olaniyi, *et al*., 2001; Gebremedhin, *et al.,* 2013).

Concomitant administration of food with oral solid dosage forms can affect both the disintegration and dissolution of the drug. The tablet disintegration can be delayed as a result of food materials forming a film coating around the tablet surface (Abrahamsson, *et al.*, 2004). Dissolution can equally be affected due to interaction between drug and the food components (Bushra, *et al*., 2011), there by affecting the dissolution and absorption of the drug. It may also be due to the effects of food on certain physiological conditions of the gastrointestinal tract (GIT). Food can modify GIT conditions such as pH, buffer capacity, gastric fluid surfactants, luminal content volume/viscosity and gastro intestinal motility pattern. These physiological changes can profoundly influence the solubility and significantly affect the rate and extent of drug dissolution and bioavailability in the body system. The great potential of the impact of food-drug interactions on drug bioavailability necessitated the US Food and Drug Administration to require studies on the effects of food on drug absorption as part of biopharmaceutic characterization of almost every new drug intended for oral administration and also for new dosage forms of already established drugs (Gibaldi, 1991; Syed, *et al.,* 2010).

Apart from the effects of concomitant administration of food on drug, embedment of solid drugs for oral administration in food bolus may also affect the disintegration, dissolution and bioavailability of such drugs. The food bolus coating on the surface of the drug, can serve as a barrier prolonging disintegration and retarding drug release into the dissolution medium. The practice of embedding drugs in food bolus is very common in some parts of Africa especially Nigeria. Solid drugs such as tablets or capsules to be administered orally are embedded in moulded food bolus made mostly from starchy food materials. This phenomenon may be referred to as drug "macroencapsulation" where by the drug serves as the core material and the food bolus serves as the encapsulating wall or shell. The reasons for this practice range from an attempt to alleviate the side effect of gastric irritation to masking the unpleasant taste and odour of the drugs. Such commonly consumed starchy staple foods include 'eba' and 'fufu' (made from cassava flour) 'amala' (made from yam flour), 'semovita' (made from wheat flour), etc. The foods are generally prepared by adding and stirring the flours in a measured quantity of boiling water to gelatinize the starch component thereby converting the flours to a thick, smooth and firm solid mass that can be cut and moulded with fingers into smaller round mass (bolus) and eaten with any suitable soups. Whereas, so many works have been done on food-drug interactions based on concomitant administration of food and drug, information on drug embedded in food bolus is very scarce. This necessitated the need for this research work.

The choice of aspirin as a candidate drug for the investigation is for various reasons. It belongs to class II of biopharmaceutical classification (BCS) with poor water solubility; hence its dissolution rate is the rate limiting step, therefore, factors affecting the dissolution will affect its absorption and bioavailability. Dissolution rate of aspirin can greatly be affected by its physico-chemical properties, formulation factors and manufacturing procedures (Bamigbola, *et al.,* 2009).

Furthermore, aspirin is a readily available commercial non-steroidal anti-inflammatory drug (NSAID). It is most commonly used as analgesic, anti-inflammatory, antithrombotic and antipyretic agents for the treatment of pain and fever with side

effect of gastro-intestinal irritation. (Gordon, *et al*., 1994; Hersh, *et al*., 2000). Therefore it is one of the candidate drugs usually embedded in food bolus to alleviate its side effect. , Furthermore, several studies have been conducted on the dissolution profiles of aspirin tablets (Elsabbagh, *et al.*, 1986; El-Din *et al*., 1989, Bamigbola *et al*, 2009), but investigation on the effect of food bolus on its dissolution profiles is not readily available. These various reasons necessitated the research into this project.

The objective of this study is to evaluate the disintegration and dissolution profiles of plain and soluble brands of aspirin tablets embedded in food bolus.

METHODOLOGY

Materials

Two brands of commercially available uncoated, immediate release (IR) aspirin tablets were obtained from a retail pharmacy at Yenagoa, Bayelsa State, Nigeria. The tablets were within their shelf life and the labelled amount of drug substance for each brand is the same (300 mg). The primary and secondary packages were well examined to ensure the physical integrity of the products.The tablets were coded P (Plain aspirin tablet), S (Soluble aspirin tablet). Twenty tablets from each brand were embedded in 3 g of freshly prepared food bolus (eba), a starchy staple food made from cassava flour and labelled PB (Plain aspirin tablet embedded in food bolus) and SB (Soluble aspirin embedded in food bolus).

Acetate buffer of pH 4.5 was used as the dissolution medium. The buffer solution was prepared by mixing 29.9 g of sodium acetate (Sigma-Aldrich, UK) with 16.6 mL of glacial acetic acid (Sigma-Aldrich, UK) and sufficient distilled water to produce 10 litres. Aspirin USP fine crystals (BDH, England) was dissolved in acetate buffer to make a series of solutions with different concentrations to develop a standard calibration graph using UV spectrophotometer (Spectronic 21, Milton Roy, USA) at 265 nm. All other materials used were of high analytical grade.

Method

Preparation of food bolus and embedment of aspirin tablets

The food bolus was made from cassava flour (garri). Garri was produced from cassava tuber (*Manihot esculenta).* The production involved washing and peeling of cassava tubers. The peeled tubers were thoroughly washed and grated into a mash to initiate the process of fermentation and detoxification. The mash was placed in a porous polypropylene bag and depressed in an adjustable hydraulic press machine for five days to remove excess starchy water and poisonous hydrocyanic acid content while fermentation took place. The fermented mash in the bag was then pressed mechanically for one hour to squeeze out the remaining fermented liquor. The dewatered mash was then broken up into small lumps by passing through a sieve and roasted in a large clay frying pot. While roasting, the mash was turned from time to time with a paddle to prevent sticking and charring. The resulting dry garri was then ground into fine flour and packed in appropriate bags and stored.

One litre of water was heated to the boiling point of 100 ^{o}C and 500 g of garri was added to the boiled water and stirred continuously to form a smooth, firm, gelatinized solid mass (eba). This was allowed to cool down. The gelatinized solid mass (3 g) was weighed on an electronic balance (Mettler Toledo, Switzerland) and sample P brand of aspirin tablet was embedded in it and moulded into a uniformly spherical bolus with hands and labelled PB. Twenty tablets from sample P were embedded using the same method. The same procedure was repeated for sample S and labelled SB. The thickness of the bolus on PB was 3.72 $\pm$ 0.15mm, while the thickness of the bolus on SB was 3.65 $\pm$ 0.21 mm

Disintegration test

The disintegration test was carried out for S and P as specified in the United State Pharmacopoeia (USP, 2000). Six (6) tablets from each brand were used. The test was carried out using Erweka disintegration test apparatus (GmbH, Germany). Each individual tablet of both soluble and plain aspirin tablets was placed in each of six tubes of the basket disc. Acetate buffer at pH 4.5 was used as the immersion fluid at 37 $\pm$ 0.5^{o}C. A standard motor driven device is used to move the basket assembly containing the tablets up and down through a distance of 56mm at a frequency of 30 cycles. The time taken for each tablet to

disintegrate completely was noted. The specification states that all the uncoated tablets should disintegrate within 15 minutes. The end point was determined when there were no particle or granules remaining on the disc. The same procedure was repeated for SB and PB. Disintegration time for all the samples are depicted in Figure 1

Dissolution Test

The *in vitro* dissolution test was carried out on S and P according to the United State Pharmacopoeia specification (USP, 2000). The USP dissolution apparatus 2 (paddle) was used at a speed of 75 rpm in 900ml of dissolution medium (pH 4.5 acetate buffer) maintained at 37± 0.5 ^{o}C using a water bath fitted with a variable speed stirrer and heater (Erweka, DT6, GmbH, Germany). 5ml samples were withdrawn manually at 5, 10, 20, 30, 45, 60, 90, 120 and 240 minutes respectively and replaced with equal volume of fresh medium to maintain a constant dissolution volume. The samples were filtered and the absorbance measured at 265nm using a UV Spectrophotometer (Spectronic 21, Milton Roy, USA). The same procedure was repeated for SB and PB. The amount of drug released was calculated using the standard calibration graph earlier developed. The dissolution profiles of all the samples are represented as cumulative percent drugs released at each sampling interval and shown in Figure 2. Each profile is the average of six tablets.

Comparative Analysis of Dissolution Parameters

In this study, model-dependent method was used to analyze the kinetics and mechanism of drug released from the dissolution profiles, Furthermore, various dissolution parameters such as percent dissolved in 30 min (PD_{30min}), dissolution rate constant (k) and time for 80% dissolution (t_{80}) were generated from the dissolution profiles for all the samples using standard procedures (Shargel and Yu, 1993). Analysis of variance (ANOVA) was used for comparison of dissolution parameters generated.

Analysis of Model Dependent Kinetic and Mechanism of Drug Release

The kinetics and mechanism of the drug release from S, P, SB and PB were determined by fitting their dissolution profile data into different mathematical models such as zero-order kinetics, first-order kinetics, Higuchi and Korsmeyer–Peppas models (Costa, *et al.*, 2003; Dash, *et al*., 2010). The model that gave the highest correlation (r^2) represented the kinetics by which the drug was released from the sample. In general, the final sample time selected for each individual profile was not beyond 80% of drug release. (Mesnukul, *et al.*, 2009). The results obtained are shown in Table 1.

Statistical Analysis of Dissolution Data

Analysis of variance (ANOVA) was used for multiple comparison of various dissolution parameters generated. At 95% confidence interval, 2 tailed p values less than 0.05 ($p < 0.05$) were considered significant.

RESULTS AND DISCUSSION

Disintegration Test

Disintegration precedes dissolution process in tablet dosage forms. In this study, disintegration test was performed on both embedded and unembedded aspirin tablets in order to ascertain the effect of food bolus on the disintegration and invariably dissolution of the embedded aspirin tablets. As shown in figure 1, the disintegration times for all the samples are in the order of S (12 $\pm$ 0.12 sec) < P (30 $\pm$ 0.35 sec) < SB (16 $\pm$ 0.84 min) < PB (18 $\pm$ 0.59 min). S and P passed the disintegration test for uncoated tablets (which specified 15 minutes) while SB and PB failed. The compact food bolus layer on the tablets prevented rapid penetration of the medium into the inner part where the drug is embedded. Therefore the external food coating barrier has to disintegrate before the tablet can also disintegrate. This prolonged the disintegration time of SB and PB. This observation was in agreement with the opinion of Abrahamsson, *et al*., (2004) who reported that tablet disintegration can be delayed as a result of food precipitate forming a film coating around the tablet surface.

***In vitro* Dissolution Tests**

The *in vitro* dissolution profiles of S, P, SB and PB are shown in Figure 2. Within 30 minutes, S has released almost all its active component (99.97%), whereas P released only 87.1%. However, both brands passed the USP dissolution requirement that

not less than 80% of the labeled amounts of aspirin should have dissolved in 30 min (USP, 2000).

Changes in the nature of the dissolution media that will increase the solubility will effectively increase the dissolution rate of the drug. The dissolution rate can also be influenced by the physicochemical properties of the substance, formulation strategies and physiological conditions of the GIT. Formulation strategies that have been employed to increase the dissolution rate of poorly soluble drugs include micronization, nano-suspensions, lipid-formulations, microemulsions, use of surfactants, solvates and hydrates and complexing agents such as cyclodextrins. (Persson, 2006) Moreover, solid dispersion, salt of weak acids and bases and buffering of the pH of the microenvironment can also be used to enhance the dissolution of poorly water soluble drugs **(**Yasir, *et al.*, 2010).

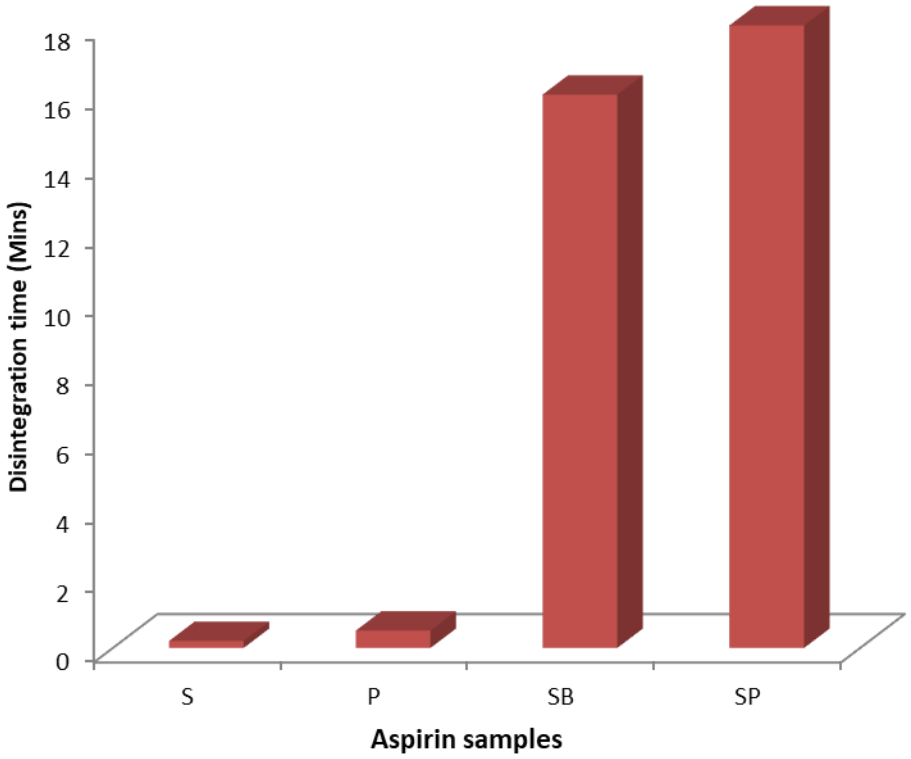

Fig 1: Disintegration time of embedded and unembedded soluble and plain brands of aspirin tablets

Brand S (soluble aspirin) employed a formulation strategy that can alter two parameters to improve its dissolution rate. It contains calcium carbonate (an alkaline excipient), which can provide a reactive medium by changing the pH of the dissolution medium around the drug to alkaline. The weakly acidic, poorly water soluble aspirin molecule can easily react with the alkaline medium to form water soluble salt (Yasir, *et al.*, 2010, Bamigbola, *et al*., 2011). Moreover, the formation of aspirin salt will increase the saturation solubility of the drug; therefore, the soluble aspirin salt can easily diffuse from the saturated (stagnant) layer, adjacent to the tablet surface into the bulk of the medium i.e. from regions of high drug concentration to regions of low drug concentration, thereby enhancing its rapid dissolution. This may account for the higher dissolution rate and shorter time for its dissolution compared to the plain brand P.

Effect of Food Bolus on the Dissolution Profiles

At 5 min S has released 44.83 % while SB released only 23.73 %. This indicated that at the initial stage, the dissolution profile of SB was significantly lower

($p < 0.05$) than S. However, at 30 min S and SB have released 99.97 % and 90.4 % respectively with no significant difference ($p > 0.05$). This show that food bolus greatly reduced the dissolution profile of SB at the initial stage, but later, the effect of food bolus drastically decreased and more drug was released from the food bolus. At 30 min S and SB met the USP specification having released more than 80 %. While S released 99.97 % within 30 min, however it took 120 min for SB to release 99.1 % of the drug.

Considering the effect of food bolus on brand PB, a significant reduction in dissolution ($p < 0.05$) was observed throughout the period. For example, at 5 min, only 2.7 % of drug was released from PB in contrast to the 33.9 % that was released by P. Brand P passed the USP specification having released 87.1 % in 30 min, while PB failed, having released 5.8 %. Even at 240 min (4 hr), PB released only 65.5 % of the drug which was still far below the USP specifications.

From all observations, it can be seen that the food bolus has a significant reduction in the amount of aspirin dissolved from SB compared to S at the initial stage (up to 20 min), but from 30 min there was no significant difference in their dissolution profiles. On the contrary, the effect of food bolus on PB compared to P was significant throughout the period of the experiment. In fact, the food bolus modified the drug release profile of PB from immediate release to a slow release dosage form.

Analysis of Kinetic and Mechanism of Drug Release

Kinetic of Drug Release

The dissolution data obtained for S, P, SB and PB were fitted to zero-order, first-order, Higuchi and Korsmeyer-Peppas models to obtain the kinetic of drug release from the samples. The zero order describes the system where the drug release rate is independent of its concentration, polymer swelling upon hydration play a prominent role in the release (Donbrow, *et al.*, 1980; Kumar, *et al.*, 2008). The first order describes the system where release rate is concentration dependent and drug within the reservoirs assumed to decline exponentially and the release rate is proportional to the residual concentration.

Higuchi describes the release of drugs from insoluble matrix as a square root of time dependent process based on Fickian diffusion. The drug release from a porous monolithic matrix involves the simultaneous penetration of surrounding liquid, dissolution of drug and leaching out of the drug through tortuous interstitial channels and pores. In bimodal or anomalous (Korsmeyer-Peppas) model, the release of the active ingredient is by diffusion coupled with polymer hydration and erosion.

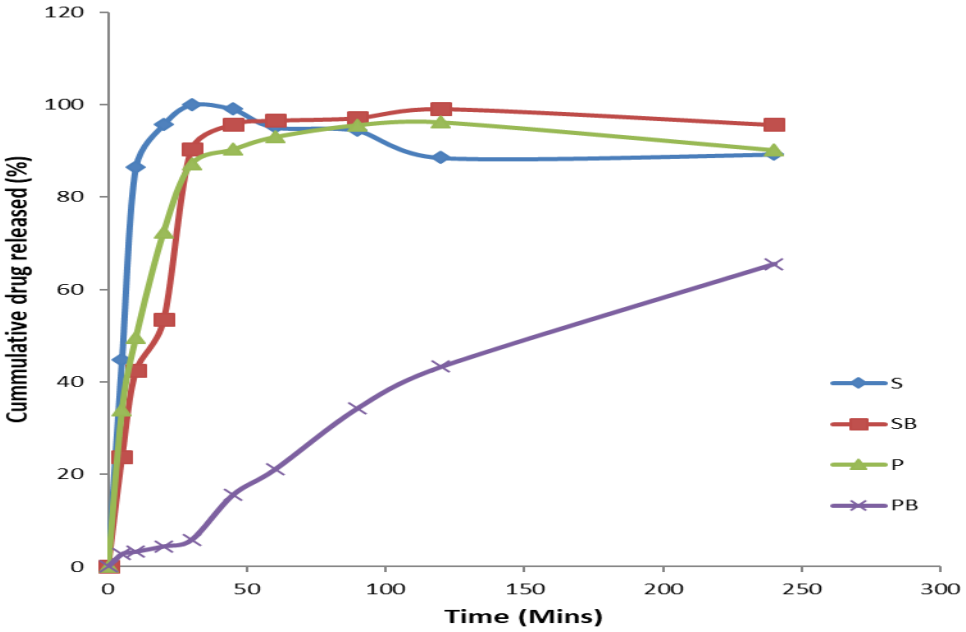

Figure 2: Dissolution profiles of embedded and unembedded plain and soluble brands of aspirin tablets

The diffusion path length undergoes change due to the polymer dissolution (Shah, *et al.*, 1989; Kamboj, *et al.*, 2009).The coefficient of correlation (r^2) was used to indicate the degree of curve fitting, the higher the value as it approaches 1 indicates a superiority of the dissolution profile fitting to the mathematical equation. The n value from the Korsmeyer-Peppas power law is the release (diffusional) exponent which characterizes the transport mechanism of the drug and is indicative of the type of release mechanism. In the case of a cylinder (which is applicable to tablets), $n = 0.45$ for fickian (case I) diffusion, $0.45 < n < 0.89$ for anomalous (non fickian) transport, $n = 0.89$ for zero order (case II) release kinetic and $n > 0.89$ for super case II release. Case II transport generally refers to the dissolution of the polymeric matrix due to the relaxation of the polymer chain and anomalous transport (non fickian) refer to the combination of both diffusion and polymer relaxation (Mesnukul, *et al.*, 2009; Moin and Shivakumar, 2010).

The data analyses of release profiles according to different kinetic models are shown in Table 1. The r^2 from the curve fitting of the drug release profile from S and P (non embedded tablets) and SB (embedded soluble tablet) showed better fit to first order model (Their r^2 for first order were higher than other kinetic models). PB (embedded non soluble tablets) showed better fit to zero order kinetics. This indicated that embedding soluble aspirin tablet in the food bolus did not change the kinetic of release from the tablet. The intrinsic formulation factors of the soluble tablets seemed to control drug release from the tablet rather than the external coating of the food bolus. On the other hand the food bolus changed the release kinetic of non soluble aspirin from first order to zero order model.

Mechanism of Drug Release

From the analysis of drug release shown in Table1, the n values for S and P (unembedded tablets) are greater than 0.89 suggesting super case II transport mechanism. In this case, when the tablets came in contact with the dissolution medium, the mechanism of drug release was due to the relaxation/dissolution process of the polymer (binder) used in the tablet formulations. This is evident in the rapid disintegration time of the tablets (12 and 30 sec for S and P respectively). This corresponded to rapid dissolution. However, the intrinsic formulation strategy of S containing an alkaline excipient which can change the microenvironment in the dissolution medium to enhance the solubility of the weakly acidic drug (aspirin) further facilitated rapid dissolution rate of S compared to P.

On the order hand, the n values for SB and PB (embedded tablets) were 0.68 and 0.87 respectively. Their n values are indicative of anomalous transport mechanism combining both drug diffusion and polymer relaxation. Drug release from SB and PB will require penetration of surrounding dissolution medium from the outside coating (food bolus layer) into the inner core, followed by disintegration and dissolution of the tablet. The effect of food bolus on both the disintegration and dissolution parameters of the embedded tablets was observed. Firstly, disintegration time for SB and PB (16 min and 18 min respectively) were prolonged due to the external coating of the food bolus on the tablets. Since disintegration precedes dissolution, prolonged disintegration may delay the dissolution of SB and PB. The compact food bolus coating barrier on the tablets prevented rapid penetration of the dissolution medium into the centre (core) where the drug are embedded, thus delaying the dissolution of the drugs.

Table 1: Analysis of kinetic and mechanism of drug release for embedded and unembedded soluble and plain brands of aspirin tablets

Formulation	Release exponent (n)	Coefficient of correlation (r^2)			
		Korsmeyer-Peppas	Zero order	First order	Higuchi
S	0.92	0.9724	0.9998	0.9999	0.9964
SB	0.68	0.9750	0.9757	0.9998	0.9608
P	0.90	0.9483	0.9760	0.9944	0.9931
PB	0.87	0.9749	0.9866	0.8707	0.9715

The food bolus made from "eba" contains starch (a hydrogel) capable of swelling when it comes in contact with water. The swollen mass forms a viscous gel barrier that can increase the diffusion path and slow down the diffusion of drug into the dissolution medium. (Bravo, *et al*, 2004; Prakash, *et al*, 2007). According to Costa and Lobo (2001), a water soluble drug incorporated in a matrix is mainly released by diffusion, while a poorly water soluble drug, will be released principally by erosion of the matrix. Similarly, the possible release mechanisms for water soluble drug embedded in food bolus may depend on the diffusion of the drug from the inner core of the food bolus to the outside bulk of the dissolution medium. On the other hand, the possible mechanism for non water soluble drug will be erosion of the food bolus as a result of gradual penetration of the dissolution medium into the compact wall formed by "eba" bolus leading to the relaxation of the polymer chain of the starch material. This can lead to gradual erosion of the compact mass creating more pores through which dissolution medium can penetrate into the core and increasing the diffusion of the dissolved drug from the core to the outside bulk of dissolution medium. (Chaubai, 2004).

The intrinsic formulation strategy of S contained an alkaline excipient which can buffer the pH of immediate microenvironment of the weakly acidic and enhance its solubility (Yasir, *et al*, 2010, Bamigbola, *et al*., 2011). Therefore, the soluble aspirin embedded in SB will act as a water soluble drug and will be released through diffusion from the food bolus where it was embedded, thereby, allowing diffusion mechanism to have an overriding effect on polymer relaxation/erosion mechanism of the starch polymer of "eba". This may be the reason why food bolus could not influence the kinetic of release in SB. The kinetic of release for S (unembedded soluble aspirin) and SB (embedded soluble aspirin) remain the same - first order model. On the other hand, since plain aspirin formulation embedded in the food bolus did not have facilitated or enhanced drug solubility excipient like the soluble aspirin, the drug remain poorly soluble in the dissolution medium. Therefore, the release of drug from PB will largely depend on the food bolus polymer relaxation and erosion while diffusion will have little impact. The kinetic of release of unembedded plain aspirin which was first order kinetic, however changed to zero order kinetic when embedded in food bolus. These reasons may contribute to the higher dissolution profile from SB compared to PB.

Statistical Analysis of Dissolution Data

Various dissolution parameters such as percent dissolved in 30 min (PD_{30min}), dissolution rate constant (k) and time for 80 % dissolution (t_{80}) were generated from the dissolution profiles for all the samples are shown in table 2. The overall relative ranking of all the samples in terms of PD_{30min} and k followed the order of S > SB > P > PB while the ranking of t_{80} followed the reverse order of S < SB < P < PB.

Table 2: Dissolution Parameters obtained from Dissolution profiles of various Aspirin Tablet Samples

Brand	Percent released in 30 min (%)	Dissolution rate constant mg/min	Time for 80% dissolution (min)
S	99.97	0.670	8.20
SB	90.33	0.385	24.57
P	87.10	0.333	25.17
PB	5.78	0.217	368.66

ANOVA conducted on the dissolution parameters generated for all the samples, showed that the dissolution profile of S was significantly higher ($P < 0.05$) than the rest. There was no significant difference between the dissolution data of SB and P and could be said to have similar or equivalent dissolution profiles. However, the dissolution profile of PB was significantly lower ($P < 0.05$) than that of SB and P.

CONCLUSION

Sample S had a more rapid disintegration with a corresponding rapid dissolution in contrast to P. Therefore, the rapid dissolution rate of S may have a good correlation with its *in vivo* bioavailability and consequently lead to rapid onset of action. Hence, S may be the drug of choice in conditions where rapid onset of action is desired. Moreover, food bolus significantly affected the disintegration and dissolution of P but had a minimal effect on S. The release profile of SB met the official specifications

and was equivalent to P. This implies that food bolus can be used successfully to mask the unpleasant taste and alleviate gastrointestinal irritation of S without significant reduction of its in vitro dissolution and by extension, in vivo bioavailability of the drug. In contrast, the release pattern of PB was significantly reduced, prolonged and modified to resemble a controlled release dosage form. This may reduce its bioavailability and consequently lead to delay in onset of action or therapeutic failure.

RECOMMENDATION

Different types of starchy food materials can be moulded into food bolus to embed aspirin tablets before oral administration. There can be wide variations in the polymer constituents of these food materials. Therefore, the type of food material and quantity of food bolus used to embed the aspirin tablets may further influence drug release profiles from the bolus and may need to be investigated.

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