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Multilayered tablets of Vitamin A palmitate using blends of a vegetable fat with Xanthan and Guar gums.

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Abstract: Multilayered tablets of vitamin A palmitate were prepared using different types, proportions and blends of two natural polymers; xanthan gum (XG), guar gum (GG) and a vegetable fat (DF) obtained from *Irvingia gabonensis* (dika fat). The effect of various formulation factors like polymer proportion, polymer type and pH of the dissolution medium on the *in vitro* release of the drug was studied, using the half change technique, in 500 ml of dissolution medium, at 100 rpm. Release kinetics were analyzed using Zero-order, Higuchi's square-root and Ritger–Peppas' empirical equations. *In vitro* release performance as revealed by the time taken for 50 and 70% of the drug to be released ($t_{50\%}$ and $t_{70\%}$ respectively), showed that the release rate depended on the type of polymer, blend ratio and proportion of dika fat incorporated. Multilayered tablets containing blends of GG and DF (3:1) as well as those containing GG and XG (3:1) were found to exhibit immediate-release characteristics as they had $t_{70\%}$ values of 42 and 48 min respectively. Tablets containing blends of DF and XG (1:3) showed $t_{50\%}$ value of 330 min and extended the release up to 8 h, while tablets containing DF and GG (1:1) showed $t_{50\%}$ value of 180 min and equally extended the release up to 8 h. Mathematical analysis of the release kinetics indicated that the nature of drug release from the multilayered tablets followed non-Fickian or anomalous release. Drug release from multilayered tablets of vitamin A containing blends of guar and xanthan gums with dika fat demonstrates the advantage of multilayer technology over the conventional monolithic matrix system in improving the performance of the single polymers.

Key words: Multilayered tablets, Vitamin A palmitate, Xanthan gum, Guar gums, Dika fat, *In vitro* release.

INTRODUCTION

Oral drug delivery continues to be the preferred route of drug administration and the use of hydrophilic matrices in achieving this has increased tremendously in the last three decades (10). However, the prohibitive cost of both synthesis of new polymeric materials and their safety, is a major reason scientists have recently focused on investigating the use of pharmaceutically approved polymeric materials as matrix functional excipients to enhance single polymer performance (4, 7, 21, 28, 29). Several drug delivery systems have been used to modulate drug release, among the systems gathering attention is the bi and multiple layer drug delivery system. Multilayered tablets for example, have been utilized to develop sustained released formulations (1). Such a tablet usually have a fast releasing layer and may contain bi or triple layers to sustain drug release (9, 19, 25, 33). A multilayered tablet is produced by initial compaction of a portion

of the fill material in a die followed by additional fill. The pharmacokinetic advantage relies on the fact that drug release from fast releasing granules leads to a sudden rise in blood concentration. However, the blood level is maintained at steady state as the drug is released from sustaining granules. Formulation of multilayered tablets for controlled release of drug is usually a technique aimed at keeping modified release formulation separate from those that are immediately bioavailable. Some of the advantages of multilayered tablets include: improved patient compliance, higher loading dose capacity, ability to release multiple bioactive ingredients, broad range of release profile, ability to separate incompatible active ingredients. The multilayered matrix system overcomes inherent disadvantage of non linearity associated with diffusion controlled matrix devices by providing additional release surface with time to compensate for the decreasing release rate (1). Like other polymeric drug delivery systems, formulation of multilayered drug delivery systems would involve the optimization of several factors, the most important of which is the selection of the polymer and testing the physical and mechanical properties of the prepared matrices. Drug release retarding polymers are the key performers in matrix systems and various polymers have been investigated as drug-retarding agents, each presenting a different approach to the matrix system. Based on the features of the retarding polymer, matrix systems are usually classified into three main groups: hydrophilic, hydrophobic, and plastic. Their equilibrium swelling capacity, solute permeability and *in vitro* performance characteristics make them valuable in drug delivery applications. Natural polymers serve as an alternative to synthetic products because of their biocompatibility, non toxicity, biodegradability, eco-friendly nature and low prices compared to synthetic products (2, 12-17, 27). They are generally non- polluting renewable sources for sustainable supply of cheaper pharmaceuticals, consequently, many recent investigations in polymeric drug delivery center on the use of natural polymers (3, 5, 6, 8, 10, 18, 26, 30). Natural gums rank among vital biomaterials relevant to economic advancement, particularly in developing countries. They have been employed as disintegrants, emulsifying agents, suspending agents and as binders (31). Guar and Xanthan gums are two natural polymers that have found wide application in drug delivery. Guar gum is a galactomannan (polysaccharide consisting of mannose backbone with galactose side group). It is derived from the ground endosperm of *Cyanopsis tetragonolobus*, a plant of the leguminosae family. It has a straight chain of D-mannopyranose units joined by β (1-4) linkages with a side chain of D-galatopyronase joined to every other mannose unit by L (1-6) linkages. Xanthan gum on the other hand, is a polysaccharide derived from the bacterial coat of *Xanthomonas campestris*. The primary structure of this naturally produced cellulose derivative is a cellulosic backbone; β-D-mannose-β-D-glucoronic acid-α-D-mannose attached with alternate glucose residue of the main chain (Wilding I.R, 2001). Xanthan gum contains glucose (37%), mannose (43.4%), glucoronic acid (19.5%), acetate (4.5%) and pyruvate (4.4%). It swells in gastric fluid to produce a highly viscose layer around a tablet through which the drug can slowly diffuse. Dika fat is a vegetable oil extract from the kernels of *Irvingia gabonensis var excelsia.* It is abundantly available in Nigeria and several reports in literature show its potential application in the pharmaceutical sector (11, 20, 22-24, 32). Although our literature search reveals an extensive report on the use of these excipients in matrix tablet preparations, there was no report of combining these three naturally occurring and abundant polymeric materials in a multilayered drug delivery system. In this study therefore, we report the preparation and evaluation of a three layered matrix tablet of xanthan and guar gums in combination with dika fat using vitamin A palmitate as the model drug.

MATERIALS AND METHOD

MATERIALS

Vitamin A palmitate (Evans Nig. Plc), Lactose, Xanthan and Guar gums (Sigma, UK). All other chemicals and reagents used were of analytical grade.

Preparation of powder mixtures

The direct compression method was used. Appropriate amount of each ingredient required to produce 50 tablets per batch were accurately weighed out and mixed thoroughly using a porcelain mortar and pestle. The composition of both the core and compression coated tablets is shown in Tables 1 and 2 respectively.

Table 1. Composition of core tablet of Vitamin A palmitate

Ingredient	Amount/tab (mg)
Vitamin A palmitate	100
Explotab	10
Lactose	10
Total weight of core tablet	120

Table 2. Composition of compression coated mixtures of Vitamin A, dika fat and the polymers

S/No	Ingredients	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
1	Vitamin A (mg)	100	100	100	100	100	100	100	100	100	100	100	100	100
2	Dika fat (mg)	200	150	100	50	0	150	150	100	50	0	100	100	100
3	Xanthan gum (mg)	0	50	100	150	200	0	0	0	0	0	150	100	50
4	Guar gum (mg)	0	0	0	0	0	0	50	100	150	200	50	100	150
5	Lactose (mg)	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	0	0	0
6	Total weigth (mg)	400	400	400	400	400	400	400	400	400	400	400	400	400

Evaluation of Powder Properties

Determination of flow parameters

The **bulk, tapped, true densities, flow rate and angle of repose** were determined using standard methods.

Hausner's ratio:

This was calculated as the ratio of tapped density to bulk density of the samples.

Compressibility Index

This was calculated using the equation:

Compressibility= (Tapped density- bulk density)/ Tapped density x 100.

Compression of three layer tablet

Powder mix equivalent to 100mg of Vitamin A palmitate (120mg) was weighed and compressed using a single station tablet press (THP Shanghai, Tianxiang ad Chentai Pharmaceutical Machinery Co. ltd, China) equipped with 9.0 mm punch die set. This is the core tablet. The second stage of compression was accomplished by placing 50% of the coating powder in the die cavity, the core tablet was then placed in the middle and the remaining 50% of the coating powder was placed in the die and compression was carried out. This was done for each tablet in each batch. Tablets weighing 400 mg each and containing 200 mg vitamin A palmitate were compressed at 23.75 kN and dwell time of 60 seconds. A total of 50 tablets per batch were prepared.

Tablet hardness and friability

A Pharmatest model PTB-311, (Germany) apparatus was used to determine the tablet crushing strength. Crushing strength was examined by placing a tablet between a stationary and moving spindle. Force was applied by turning the moving spindle until the tablet cracked diametrically. The friability of the compacts was evaluated from the mass loss of 10 tablets tumbled for 100 revolutions (25 rpm for 4 minutes) using a friabilator (Erweka, Germany).

Swelling studies

The method reported by Emeje et al[1] was adopted for the study.

In vitro Drug Release Studies

The ability of matrix tablets of Vitamin A to remain intact in the physiological environment of the stomach and small intestine was assessed by conducting drug release studies using the half change technique: This mimics mouth to intestinal transit; drug release studies were carried out using USP dissolution rate apparatus (Apparatus 1, 100 rpm, 37°C) for the first 2 h in pH 1.2 simulated gastric fluid (SGF) without enzymes (500 ml). Then the dissolution medium was changed to pH 7.4 simulated intestinal fluid (SIF) without enzymes (500 ml) and tested for drug release for the remaining 6 h. Five (5) milliters aliquots of the dissolution medium were withdrawn at hourly intervals up to 8 h. The withdrawn amount was replaced with an equal volume of fresh dissolution medium kept at 37°C. The withdrawn samples were analyzed at 326 nm for vit. A content using a Shimadzu UV Spectrophotometer (Shimadzu, Japan). The data presented here is for quadruplicate determinations. For each dissolution profile, the release data was analyzed by fitting in the different kinetic equations to elucidate the release mechanism.

RESULTS AND DISCUSSION

Powder properties

The micromeritic properties of the different drug – polymer mixtures used are given in Table 3. There was no appreciable difference in the bulk and tapped densities of all the formulations. The tapped density measurement of the mixtures show that the core formulation containing only lactose and explotab (batch F1) had the highest value while those containing equal proportion of guar gum and dika fat gums (batch F9) had the lowest value. Low values of density imply the presence of a comparatively higher number of possible enclosed voids. The results indicate that blending produced intermediate values, with neither too high nor too low values. The compressibility index (CI) is an indication of changes that occur in the packing arrangement while tapping the powder, and is a direct measure of the propensity of a powder to consolidate when undergoing vibration, shipping and handling (10). Table 2 shows that this compressibility index was highest for batch F10 (containing GG/DF at ratio 3:1) which expectedly had a low flow rate and a high angle of repose, thereby corroborating the results. Only batches F7 and F8 (containing DF alone and GG/DF 1:3 respectively) had CI values less than 15 %, indicating a relatively better flow. The results of angle of repose of these two batches were less than 40^{o}, corroborating the CI and flow rate results (Table 3). CI between 5 – 15 % indicates excellent flow properties. Flow rate rather than CI is a direct measurement of powder flowability (10). Generally, values of the angle of repose for all the formulations show that, the powders have fair flow potentials. Blending was also found to marginally improve flow as indicated by the angle of repose of batch F2; the core preparation (did not flow at all). Flow indices of all the batches generally indicate poor flow properties (Table 3). The values show that the core batch (F1) containing lactose and explotab without the gums or DF had better flow properties, with flow decreasing significantly ($P < 0.01$) with the addition of the polymeric excipients. Hydrophilic gums such as guar and xanthan gums used in this study are generally very cohesive in nature (10), and this may have contributed largely to the poor flow properties exhibited by the batches containing these gums. Usually, powders with good flow properties should have angle of repose < 40°, Hausner's ratio < 1.25 and Carr's index < 20%. Glidants will therefore be an important constituent in the large scale production of these multilayered tablets as this would enhance flow and thus ensure weight and content uniformity.

SWELLING STUDIES

Image analysis (Fig. 1) during the swelling of the multilayered tablet matrices in three different media; water, SGF and SIF showed increase in both axial and radial dimensions (Tables 4, 5 and 6). The swelling rate was observed from the percent normalized size increase which was calculated as the radial length increase with respect to the initial value (to avoid error due to "lens effect"). The results show that matrix swelling was dependent on both the pH of the media and the tablet composition. For example, batch F1 had higher swelling capacity in SIF than in SGF and water (Tables 4, 5 and 6). This observation was not unexpected, as explotab being a modified starch (carboxymethyl starch), is remarkably effective for rapid disintegration (superdisintegrant) and this has been attributed to its pH dependent swelling capacity. Expansion of tablets containing this disintegrant at alkaline pH of the SIF was more than in the acidic pH of the SGF and water because of the relatively higher solubility in SIF. Interestingly, this batch also had the lowest swelling capacity irrespective of the medium of investigation. The tablet could only increase by 40, 70 and 75 times its original size in water, SIF and SGF respectively after 8 hours of swelling studies. Worthy of note is the highest swelling capacity exhibited by batch F4 (containing XG/DF at 1:1 ratio) in water. The extensive swelling (220 times the original size of the tablet), is attributable to the presence of xanthan gum in the preparation. It is also important to note that, the initial (first 60 min) swelling of batch F4 was

lower compared to other formulations (F8 – F10, F11, and F13 – F14). Formulations containing mixture of XG and DF (F3 – F5) swelled more than those containing XG alone (F6). Although DF is hydrophobic, it is reasonable to think that, its presence in batches F3 – F5 may have contributed to the higher swelling noticed. This is because, dika particles could have coated the gum surfaces thereby reducing the rate of fluid imbibation, but once fluid penetration was achieved, the gum particles could retain much of the fluid resulting in extensive axial expansion. This would be different from the expected rapid swelling and erosion with the hydrophilic XG. This same trend was noticed with batches containing guar gum alone (F11) and GG with DF (F8 – F10). Comparing XG multilayered tablets with those of GG, it was discovered that, GG preparations had a very high initial fluid uptake and a gradual swelling was maintained up to 5 hours with subsequent loss of tablet integrity (crumbling). On the contrary, XG preparations, had very slow initial water uptake, but most of the tablets did not crumble even after 8 hours of study, except batch F4.The differences in the swelling rates of the matrices, which were most significant in the first 60 minutes, could be due to a different speed of medium penetration into the tablets. Such behavior may depend on a slower initial interaction between the medium and the polymer-drug system and could equally account for the initial rapid release observed during dissolution. After the initial period, the formation of a less porous and stronger gel layer, which limits fluid uptake, could increase the diffusion pathway and decrease gel erosion. Irrespective of the dissolution medium, the combination of these polymeric materials with dika fat practically resulted in increased swelling of the multilayered tablets. An exceptional observation was the attenuated swelling of GG containing tablets noticed in SGF. Batch F11 (containing GG alone), showed higher swelling capacity than its blend batches (F8 –

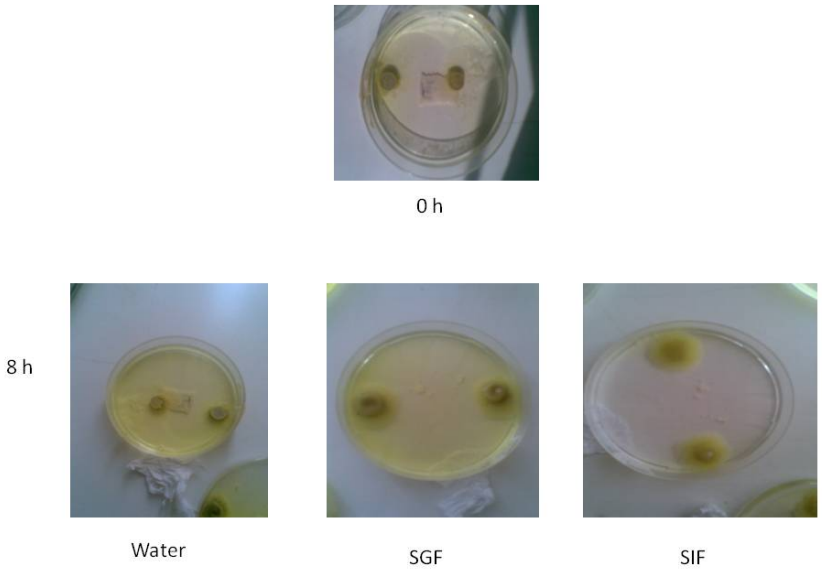

Fig. 1 Representative sample compacts showing the swelling dynamics of batch F10 containing blends of guar gum and dika fat in ratio 3:1.

Table 3: Micromeritic properties of powder mixtures containing vitamin A with dika fat, guar and xanthan gums

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Batch	Angle of Repose(°)	Flow rate (g/s)	Bulk density (g/cm3)	Tapped density (g/cm3)	CI (%)	HI
F1	28.000±2.54	1.770±0.25	0.705±0.00	0.857±0.00	17.74	1.22
F2	0.000±0.00	0.000±0.00	0.509±0.02	0.600±0.02	15.17	1.18
F3	42.200±2.54	0.500±0.20	0.527±0.03	0.625±0.00	15.68	1.19
F4	43.700±0.30	0.430±0.06	0.536±0.03	0.683±0.03	21.52	1.27
F5	42.900±1.04	0.330±0.06	0.517±0.02	0.653±0.02	20.83	1.26
F6	39.800±0.52	0.400±0.00	0.683±0.03	0.833±0.00	18.01	1.22
F7	38.700±2.70	0.530±0.21	0.548±0.11	0.600±0.02	8.67	1.09
F8	38.300±1.30	0.600±0.10	0.509±0.02	0.577±0.02	11.79	1.13
F9	41.100±1.00	0.570±0.06	0.485±0.03	0.613±0.02	20.88	1.26
F10	41.300±1.80	0.400±0.10	0.501±0.03	0.693±0.02	27.71	1.38
F11	36.700±1.30	0.730±0.06	0.600±0.02	0.751±0.03	20.11	1.25
F12	41.300±1.40	0.300±0.10	0.457±0.01	0.615±0.02	25.69	1.35
F13	41.500±1.50	0.400±0.10	0.508±0.02	0.670±0.02	24.18	1.32
F14	45.000±2.70	0.430±0.15	0.469±0.01	0.636±0.02	26.26	1.36

CI, compressibility index; HI, Hausner's ratio

Table 4. Effect of Polymer Type, concentration and blends on the axial expansion of vit. A multilayered tablets in water

Batch/Time (h)	0	1	2	3	4	5	6	7	8
F2	0	15	25	35	35	45	45	40	40
F3	0	30	120	120	120	120	105	95	85
F4	0	30	50	50	50	220	55	45	45
F5	0	35	70	70	100	100	100	100	90
F6	0	20	60	60	80	80	80	65	60
F7	0	20	35	35	50	50	50	50	50
F8	0	115	125	125	135	145	120	130	130
F9	0	150	160	160	160	170	155	160	160
F10	0	110	115	115	115	130	140	150	50
F11	0	85	100	100	100	100	75	80	85
F12	0	50	105	105	120	110	130	70	75
F13	0	140	190	190	160	150	105	60	100
F14	0	125	150	150	125	115	150	20	85

Table 5. Effect of Polymer Type, concentration and blends on the axial expansion of vit. A multilayered tablets in SGF

Batch/Time (h)	0	1	2	3	4	5	6	7	8
F2	0	40	40	30	50	65	60	60	75
F3	0	75	50	60	90	90	80	70	70
F4	0	50	45	50	65	60	75	75	65
F5	0	45	45	55	55	65	75	65	80
F6	0	50	60	60	60	65	65	60	70
F7	0	10	45	45	45	60	50	60	60
F8	0	135	80	70	80	90	70	80	80
F9	0	80	80	100	100	85	70	60	65
F10	0	90	100	115	105	100	75	65	110
F11	0	65	125	120	100	55	60	50	55
F12	0	65	75	75	75	100	95	55	85
F13	0	60	75	65	65	90	80	45	65
F14	0	60	80	90	50	110	90	60	105

Table 6. Effect of Polymer Type, concentration and blends on the axial expansion of vit. A multilayered tablets in SIF

Batch/ Time (h)	0	1	2	3	4	5	6	7	8
F2	0	15	15	50	55	50	60	70	60
F3	0	75	75	65	85	75	80	65	75
F4	0	65	80	75	70	65	85	85	70
F5	0	55	60	80	90	75	70	75	85
F6	0	45	65	70	70	65	50	50	50
F7	0	15	35	35	45	50	70	65	70
F8	0	65	80	85	90	80	85	80	90
F9	0	75	100	105	115	95	115	105	85
F10	0	100	130	140	150	140	140	150	145
F11	0	60	80	110	95	95	90	110	110
F12	0	70	70	80	85	90	90	95	90
F13	0	55	55	75	55	75	70	90	90
F14	0	80	65	90	70	100	100	80	100

TABLE 7: Pharmacotechnical properties of multilayered tablets of vit. A containing dika fat, guar and xanthan gums

Batch	Hardness (KgF)	Frability (%)	$T_{50\%\ (h)}$	$T_{70\%\ (h)}$	Content uniformity (%)	Release exponent (n)
F2	4.58±0.48	0.66	3.00	7.00	99.8	1.52
F3	4.80±0.37	0.07	0.80	1.30	99.0	1.80
F4	4.48±0.11	0.88	2.00	4.80	99.7	1.54
F5	4.76±0.17	0.67	5.50	----	99.8	1.45
F6	5.60±0.14	0.60	1.00	1.50	99.9	1.80
F7	4.84±0.09	0.60	0.80	1.20	99.9	1.85
F8	5.08±0.11	0.17	0.50	0.70	100.0	1.76
F9	4.20±0.00	0.41	3.00	----	101.1	1.48
F10	4.28±0.11	0.11	0.50	0.70	100.0	1.66
F11	4.68±0.18	0.86	0.80	1.00	100.0	1.89
F12	4.24±0.09	0.62	1.00	1.20	100.1	1.80
F13	4.20±0.12	0.99	1.20	1.40	99.9	1.75
F14	4.12±0.05	0.90	0.50	0.80	98.9	1.95

$T_{50\%}$ & $T_{90\%}$, time taken to release 50 and 90 % of vit. A respectively.

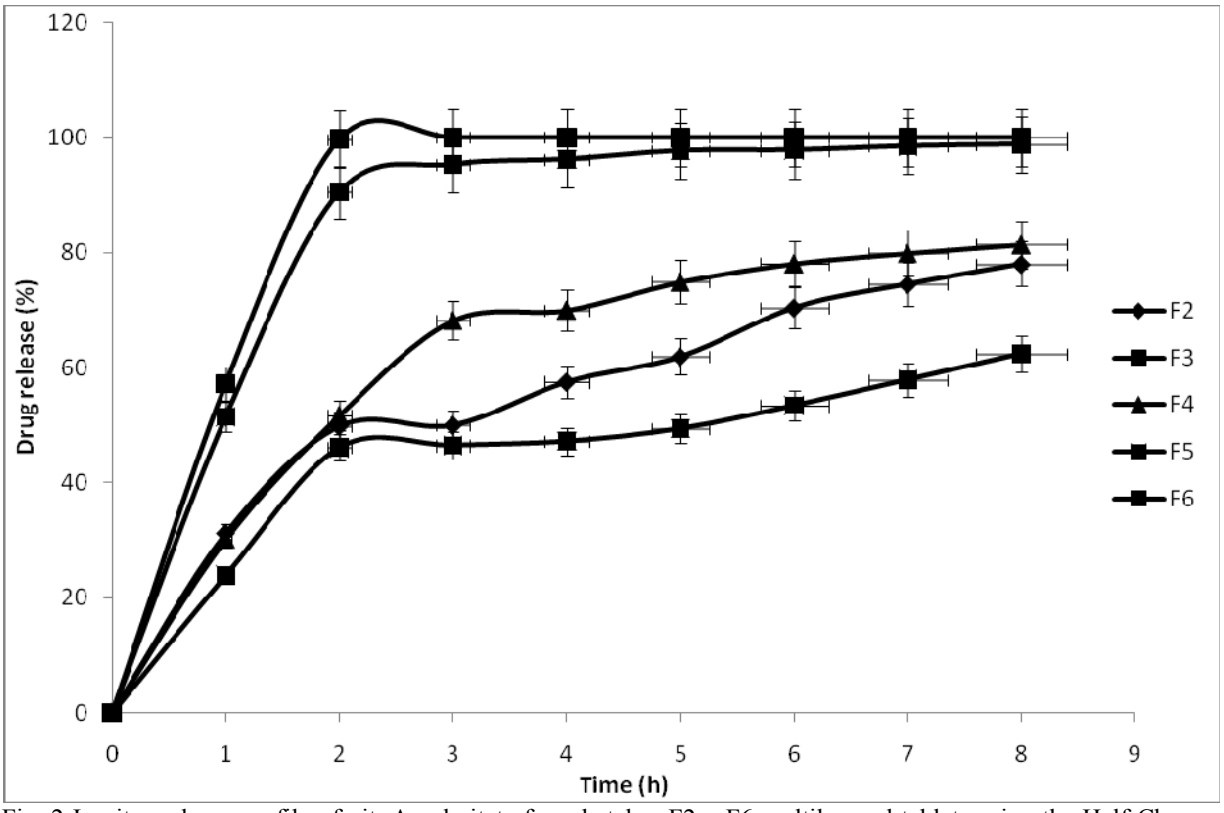

Fig. 2 In vitro release profile of vit. A palmitate from batches F2 – F6 multilayered tablets using the Half Change Technique

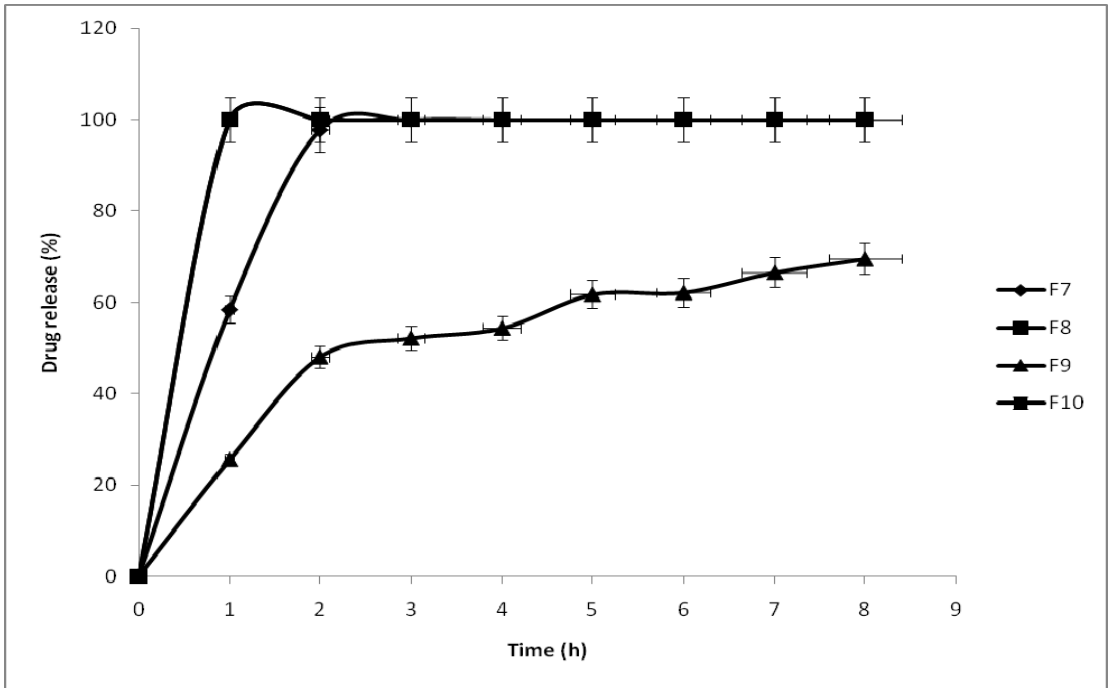

Fig. 3 In vitro release profile of vit. A palmitate from batches F7 – F10 multilayered tablets using the Half Change Technique

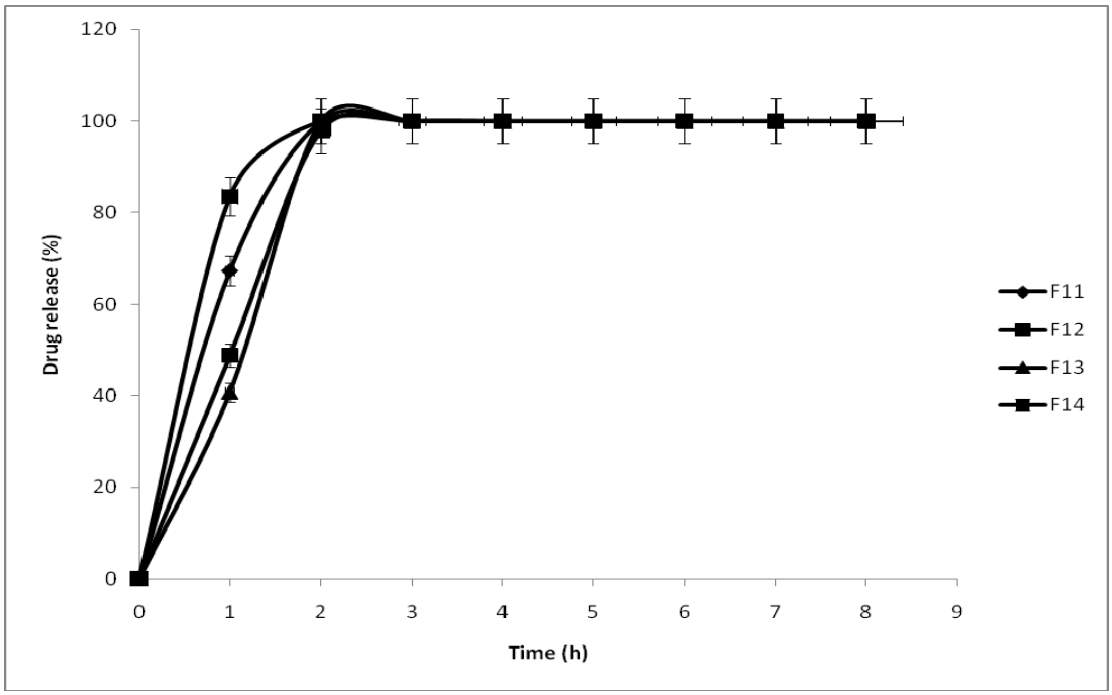

Fig. 4 In vitro release profile of vit. A palmitate from batches F11 – F14 multilayered tablets using the Half Change Technique

F10). The rest formulations showed increased swelling in SGF, with the blends having reduced hydration and spread of the polymer. In any case, the blend tablets were observed to swell more rapidly in the first hour than the GG tablets.

Tablets containing ternary blends of GG/XG/DF at 1:1:1 and 3:1:1 (batches F13 and F14) lost their structural integrity after 3 hours in water, while those containing GG alone and blends of XG/DF (F5) as well as GG/DF (F10) were intact even after 7 hours. In SIF, only the formulation containing GG alone (F11) lost its integrity within the same period. Similarly, in SGF, only one formulation (GG/DF at 3:1 ratio) lost its integrity and this in just one hour.

Physical characterization of the matrix tablets

The physical appearance, tablet hardness, friability, weight variation and drug content uniformity of all tablet formulations were found to be satisfactory (Table 7). The hardness values for tablets containing GG or XG alone were significantly ($P > 0.05$) different from those containing the polymers with DF. However, hardness values for GG containing tablets were slightly less than those with XG and XG blends. The result of friability test showed that formulations containing XG were less friable than those containing GG. The manufactured tablets also showed low weight variation and a high degree of content uniformity, indicating that the direct compression method is an acceptable method for preparing good quality multilayered matrix tablets of vitamin A.

***In vitro* Drug Release Studies**

Dissolution test results (Figs. 2 – 4) show that only batches F2 (containing DF alone), F4 (containing DF and XG; 1:1), F5 (containing DF and XG; 1:3) and F9 (containing DF and GG; 1:1) exhibited controlled release properties. Batch F5 (containing DF and XG; 1:3) was found to possess the best sustained release property as it released only 50 % of the drug in about 5 h. The time taken for this batch to release 70 % of the drug ($t_{70\%}$) could not be reached before end of the experiment (8 h). All the other formulations, irrespective of type or concentration of polymers, were not effective in sustaining vitamin A release from the matrix tablets. For example, batches F8 (containing DF and GG; 3:1), F10 (containing DF and GG; 1: 3) and F14 (containing GG and XG; 3:1) all released 70 % of their drug content in less than 60 min (Table 7). This is an indication that combining these polymers with DF at these ratios could serve as binder in immediate rather than sustained release solid dosage formulations. It was noticed that, these formulations were all containing XG, it is therefore reasonable to attribute the inability of the formulations to sustain drug release for a long time to the high hydrophilic property of GG, which may have also been aggravated by the combined effects of the highly water soluble lactose and explotab, a superdisintegrant. In any case, the performance of batches containing single polymers (F6 and F11) was significantly extended by the blends. As can be seen in Table 7, the $t_{70\%}$ for F6 and F11 were 90 and 60 min respectively compared with for example batch F4 which contains equal ratios of XG and DF with a $t_{70\%}$ of 4.8 h (Figs. 2, 4 and Table 7). The effect of polymer blends on drug dissolution shows that, tablets formulated with 50 % GG and XG individually released 70 % of their drug content in just 60 and 90 min respectively. XG or GG with DF and XG/GG with DF were blended at three different ratios: 1:1, 1:3, and 3:1. The results show that, blends of XG with DF at ratio 3:1 performed better than all the other blends in extending drug release. For example it released 50 % of the drug in 330 min (Table 7) compared to the 60 min for the formulation containing only XG. However, blend of GG with DF at ratio

1:1 performed better than GG alone in extending drug release. It released 50 % of vit. A in 180 min (Table 7) compared to 48 min by GG alone.

Release Mechanism

The n values for all the formulations ranged from 1.45 to 1.95 (Table 7) indicating that their release mechanism was non-Fickian or anomalous (n > 1.0). This implies that release from these formulations was dependent on drug diffusion and polymer relaxation. The correlation coefficients (r values ranged from 0.75 to 0.99; 0.90 to 0.99, 0.99 to 1.00 for zero order, Higuchi and Ritger-Peppas models respectively) was poor for zero order and this may be due to the drug release mechanism. It was observed (Fig. 1) during the swelling studies that the matrix tablets undergo significant swelling which was largely dependent on the pH of the dissolution medium.

Conclusion

In this study, blending a natural polymer with a vegetable extract like dika fat in the formulation of a three layered matrix tablet resulted in better tableting performance when compared to the polymer blends or individual polymer's performance. The results of drug dissolution studies showed improved drug release retardation effects of the polymers when blended with dika fat. Blending xanthan or guar gum with a vegetable fat could achieve equivalent or better performance. Generally, blending these natural polymeric materials did not alter the drug release mechanism.

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