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Research article

Design and Evaluation of Oral Dissolving Films of Chlorpheramine From Native and Modified *Enterolobium cyclocarpum* Gum

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ABSTRACT

Pharmaceutical excipients of natural origin have numerous advantages which include biocompatibility, non toxicity and biodegradability. Selection of a suitable film-forming polymer is important in the formulation of oral fast dissolving films. This work aims to investigate a natural gum from *Enterolobium cyclocarpum* tree, as a film forming polymer in chlorpheniramine oral film formulations; comparing it with hydroxylpropylmethyl cellulose (HPMC). Enterolobium gum was modified, using acetic anhydride (acetylation) and ethylene glycol. Physicochemical properties of native and modified gums were determined. Oral dissolving films were prepared from blends of HPMC and either native, acetylated or ethylene glycol modified gum, using the solvent evaporation technique. Films were evaluated for weight variation, thickness, folding endurance, in-vitro disintegration and release properties. FT-IR revealed no adverse chemical interaction. High moisture content was shown by the swelling index determination; acetic anhydride modified gum had the highest ($p<0.05$). The gums were of neutral pH, the modification methods significantly reduced viscosity of the gum. Native and modified gums produced films of acceptable qualities. Modification by acetylation produced films with better mechanical properties. Films produced with blends of native gum/HPMC and acetylated gum/HPMC had better release profile than those produced by HPMC. Drug release from the films improved with increasing concentration of the gum, up to an optimum gum/HPMC blend ratio of 2:3. Physicochemical properties of Enterolobium gum improved by gum modification. Enterolbium gum proved to be a suitable polymer in chlorpheniramine oral dissolving films. Modification by ethylene glycol produced films with best drug release profile.

Keywords: *Oral dissolving films, Enterolobium gum, Chlorpheniramine, Natural polymer*

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INTRODUCTION

Several pharmaceutical researches are focused on developing new drug delivery systems, with emphasis on achieving ease of drug administration and wide patient acceptance while not compromising therapeutic efficacy. Oral fast-dissolving drug-delivery systems were developed in the late 1970's to overcome the swallowing difficulty associated with solid dosage forms (Naziya-Khatoon et al., 2013). Oral film is an example of oral fast dissolving delivery system; mode of administration is by placing it on the tongue where it gets hydrated by the saliva and the drug content is released (Nagendrakumar et al., 2015; Shanmugam, 2016). Oral films are an alternative to the conventional oral solid dosage forms. Some of the advantages of films as a dosage form are ease of administration which does not need water, ability to dissolve rapidly, giving high bioavailability and overcome the problem of swallowing difficulties which is common in geriatrics, paediatrics, dysphagic and bedridden patients (Nitesh et al.,2012; Muhammad et al.,2015). Using both the buccal and the sublingual routes, drugs in oral films are rapidly absorbed into the reticulate vein, and then drained into the systemic circulation for rapid onset of therapeutic action (Smart, 2005). Several active ingredients (e.g. anti-asthmatics, sedatives and anti-hypertensives) could be incorporated into films, provided they are low dose and does not possess repulsive or irritating taste.

Chlorpheniramine, an antihistamine is indicated in the management of allergic reactions of the skin and mucous membrane. It is used in conditions such as urticaria, atopic

dermatitis, allergic rhinitis and hay fever. Other indications include symptomatic relieve of pruritis ani and vulva, generalised pruritis, and insect bites (The Pharmaceutical codex, 1994).

In the formulation of oral films, it is essential to use a suitable film forming polymer that is capable of imparting the needed toughness and robustness, so that the film can withstand the stress of transportation and handling during use. The use of synthetic and natural polymers has been reported in film formulations. The polymers employed include Pullulan, maltodextrin, hydroxypropylmethyl cellulose, polyvinyl pyrrolidone and sodium carboxyl methyl cellulose and starches. The use of gums in the formulation of oral films is not yet popular (Shanmugam, 2016; Ayorinde et al., 2016; Shaikh, 2013; Maheswari et al., 2014). Natural polymers have the advantages of non-toxicity, biodegradability, biocompatibility and wide availability over the synthetic ones (Patil, 2014; Nagar et al., 2011; Bala et al., 2012, Odeniyi et al., 2015).

Gums are natural polymers obtainable from trees. They are pathological products of plant, extracted through the process of gummosis such as mechanical injury to plants, attack by microorganisms or during periods of drought (Goswani et al., 2014; Ayorinde and Odeniyi, 2012).

The plant, Enterolobium cyclocarpum is native to the region of the Americas and widely distributed around the world including Nigeria. The tree serves as shade trees to coffee plantation, the seed is edible and the leaves are used as forage for cattle. Enterolobium gum obtained from the tree has been used as excipients in bioadhesive microspheres and sustained release formulations (Ayorinde et al., 2017); suspending and emulsifying agent (Adetunji et al., 2016). This present work therefore aims at investigating the effects of gum modifications on the physicochemical properties of Enterolobium gum, and evaluating the polymer as film-forming excipient in chlorpheniramine formulations.

MATERIALS AND METHODS

Materials

Enterolobium gum was obtained from *Enterolobium cyclocarpum* tree at the botanical garden, University of Ibadan, Ibadan, Nigeria. Hydroxypropylmethyl Cellulose, HPMC (GPR Hopkins and Williams Ltd. Stanheat Essex, England), Chlorpheniramine powder (Sigma Chemicals, St. Louis, USA). All the reagents used were of analytical grade and were used as supplied.

Methods

Collection and Preparation of the gum

Enterolobium gum was collected from the incised trunk of *Enterolobium cyclocarpum* tree, authenticated at Botany Department, University of Ibadan, Nigeria. The gum was purified, using established methods (Ayorinde and Odeniyi, 2012); briefly, the gum was hydrated in 0.5:99.5(v/v) chloroform/water mixture for five days with intermittent stirring. Extraneous materials were removed by straining through a muslin cloth. The gum was precipitated from solution using absolute ethanol and filtered. The precipitated gum was washed with diethyl ether, and then dried in hot air oven at 50^0C for 18 hours. The dried gum was pulverized using a laboratory blender (Mikachi MK-999, China) and screened through a 0.25mm mesh size sieve to obtain a uniform size fraction.

Modification of Enterolobium Gum

Native gum (NG) was modified, using acetic anhydride and ethylene glycol. In ethylene glycol modification, 35g of Enterolobium gum sample was dispersed in about 50mL of distilled water in a beaker heated on a water bath (Gallenkamp model DKZ) to 70^0C. About 11.5g of ethylene glycol was added to the dispersion, with constant stirring at that temperature for about 10 minutes. The mixture was allowed to cool to room temperature and then dried in the laboratory oven at 50^0C. Thus, ethylene glycol modified gum (EG) was prepared.

Acetylation modification was carried, using the method reported by Adeyanju *et al*., (2015). Quantity (40g) was dispersed in 200ml distilled water and constantly stirred for 30 minutes to form a slurry. Using 3% NaOH, the slurry was adjusted to pH of 8.0. Acetic anhydride (4.8 g) was then added to the slurry and reaction allowed to proceed for another 5 minutes, after which the pH was adjusted to 4.5 with 0.5M HCl. The slurry was then washed with ethanol to obtain the acetylated gum. This was dried in the laboratory oven at 50^0C. Gum modified by acetylation (AG) was thus produced.

Viscosity

The viscosity of 1% w/v native Enterolobium gum was determined using a Brookfield Viscometer (Brookfield Engineering Laboratories, Middleboro, MA, USA) with spindle 4. The procedure was carried out for the acetylated and ethylene glycol modified gums.

Swelling Index

Quantity (1g) of the gum sample was placed in 15mL calibrated centrifuge tubes and the volume occupied was noted as V_1. Distilled water (10mL) was added and the contents were mixed on a vortex mixer (XH-Stuart) for 2mins. The mixture was allowed to stand for 10mins and then centrifuged at 1000 revolutions per minute for 10 minutes on a bench top centrifuge (Model 80-2). The supernatant was carefully decanted and the volume of sediment recorded as V_2. The swelling index was calculated thus:

$$S = V2/V1 \quad \text{(1)}$$

Where S = Swelling index,
V1 = volume occupied by the gum before hydration and
V2 = volume occupied by the gum after hydration.

Fourier Transform Infra-red Spectroscopy

The FT-IR spectroscopy of native and modified enterolobium gum was obtained on an IR spectrophotometer (Perkin Elmer, 2000, USA) using KBr disk (approximately 2mg samples in 200mg KBr). The scanning was done in the range 400-4000cm^{-1}.

Water Hydration Capacity

The gum was tested for its water holding capacity using the American Association of Cereal Chemists (AACC) approved

method no88-04 as reported by Berton *et al.* (2002) with slight modifications. About 0.5g of the gum was mixed with distilled water (5mL) in a test tube already calibrated and weighed; this was centrifuged at 2000 rpm for 10 minutes. Any supernatant was decanted and the tube re-weighed. The absorbed water calculated as the difference below;

Water hydration capacity =

$$\frac{sediment\ weight - Sample\ weight}{Sample\ weight} \quad \text{.....(2)}$$

Determination of pH of the gum

A quantity (1g) of the native gum was weighed and placed in a 100mL beaker and distilled water added to make up to the 100 mL mark forming a 1% w/v dispersion. The dispersion was allowed to hydrate for some hours and then the pH determined using Digital pH meter (Eutech instruments, Singapore).

Flow Rate

The flow rate was determined using the method reported by Chukwuemeka *et al.* (2012). Quantity 15g of the gum was weighed and transferred into a blocked glass funnel. The plug at the mouth of the funnel was removed, and the time taken for the sample to completely flow out onto the horizontal surface was measured with a stop clock. Flow rate was calculated for using equation below

$$\text{Flow rate} = \frac{W}{t} \quad \text{..... (3)}$$

W is the mass of the powdered gum, and t is time taken for complete flow out of powder from funnel.

Particle size analysis

The particle size distribution and photomicrography of the gum samples was carried out using an Acuscope® microscope with TSView® software (China).

Preparation of the Films

Solvent evaporation technique was employed in the film preparation (Shaikh, 2013; Ayorinde *et al*., 2016). Chlorpheniramine (60mg) was dispersed in 25mL of polymer blends containing either native or modified gum or HPMC in the ratios 4:1, 3:2, and 2:3. The codes and constituents of each formulation are presented in Table 1. About 0.5mL propylene glycol was added as a plasticizer and allowed to stand overnight for bubbles to clear. The mixture was poured into a clean plastic petri dish and then dried in laboratory oven at 60^0C for about 2hours. The films were removed from plate and cut into pieces of 2.5cm by 1.5cm. Films that could not be removed from the plate were seen to have failed (Jaiyeoba *et al.*, 2013). Films were prepared from the native gum/HPMC (NG/HP), acetylated gum/HPMC (AC/HP) and ethylene glycol/HPMC (EG/HP) blends.

Evaluation of Film Properties

Physical Appearance: The films were examined by physical inspection for transparency, homogeneity and colour. The surface texture was also evaluated by having a feel of the film.

Weight variation: The cast film was cut into pieces of 2.5cm by 1.5cm film. Each cut film was weighed using electronic balance and the weight variation determined.

Thickness: The film thickness was measured using a micrometer screw gauge at five points (the four edges and centre).

Determination of surface pH

A film from each formulation was dispersed in about 2mL distilled water in a petri plate and allowed to be in contact with the electrodes of the pH meter (Eutech instruments, Singapore) after equilibrating for 1minute. Determinations were carried out in triplicates.

Folding Endurance

Randomly selected films from each formulation were repeatedly folded at the same point under bright light until any sign of breakage was seen. The number of times the films was be folded without any breakage or presence of any visible cracks was determined (Vaishali and Kashmira 2012; Jaiyeoba *et al*., 2013).

In vitro Disintegration

This was carried out as reported by Nitesh *et al.* (2012). Film (2.5 by 1.5cm^2) was placed on a glass plate containing 25mL distilled water and swirled every 10 seconds. The time a film starts to break was noted as the disintegration time.

Table 1:
Formulations and their Constituents

Formulation Code	Constituents	Nature of Gum	Type of Modification	Gum/HPMC Ratio
HPMC	HPMC	-	-	100% HPMC
NG4/HP1	Gum+HPMC	Native	-	4:1
NG3/HP2	Gum+HPMC	Native	-	3:2
NG2/HP3	Gum+HPMC	Native	-	2:3
AG4/HP1	Gum+HPMC	Modified	Acetylation	4:1
AG3/HP2	Gum+HPMC	Modified	Acetylation	3:2
AG2/HP3	Gum+HPMC	Modified	Acetylation	2:3
EG4/HP1	Gum+HPMC	Modified	Ethylene glycol	4:1
EG3/HP2	Gum+HPMC	Modified	Ethylene glycol	3:2
EG2/HP3	Gum+HPMC	Modified	Ethylene glycol	2:3

In vitro Dissolution Test

The dissolution studies were carried out, using the USP apparatus (RCZ-6C3 medicine dissolving instrument, China). The film sized 2.5 by 1.5cm2 was placed in the basket, lowered into dissolution flask holding the medium (500ml distilled water) at 37±0.5°C and rotation speed of 50rpm. 5mL aliquots were withdrawn at pre-determined interval times of 1, 3, 5, 10, 15, 20 and 30 minutes respectively and quickly replaced with fresh distilled water of same volume. Absorbance of withdrawn aliquots was determined on UV-Visible spectrophotometer at the wavelength of 264nm.

Statistical Analysis

Results obtained were analyzed statistically using ANOVA. Wherever more than two sets of data were obtained, posthoc Turkey's test was used to determine the level of significance (p-value) of an effect or the difference between means. Significant parameters at 95% confidence were considered significant or different at p = 0.05.

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RESULTS

Physicochemical Properties

Results of the physicochemical properties of native and modified Enterolobium gum are presented in Table 2. High moisture content with no significant difference between the native and modified gums was obtained. Modification by ethylene glycol reduced the swelling capacity of the gum while there was no significant difference between the swelling capacity of both acetylated and native gums. Enterolobium gum displayed a high viscosity, which was reduced by the two modification methods. The gum became more acidic with ethylene glycol modification while acetylation made the gum more neutral in pH. FT-IR showed that there was no major shifting and appearance of any new prominent characteristic peak as a result of the API. Ethylene glycol modified gum was found to have the largest particle size; the ranking was EG > AG > NG.

Properties of Chlorphenramine Films

Table 3 contains properties of the formulated films. Folding endurance of films prepared with only HPMC was higher than formulations from NG/HPMC blends while films prepared from AG/HPMC blends had comparable mechanical strength with HPMC formulations. Disintegration time for the films ranged from 66 – 160seconds.

Dissolution Profile of Films

The dissolution profiles of chlorpheniramine film formulations are presented in Fig.4. The release profile of films prepared with HPMC and NG/HPMC blends were comparable, while better release was shown by the blends prepared with modified gums.

Table 2:
Physicochemical Properties of Native and Modified Gums (mean± s.d. n=3)

Properties	Native gum	Ethylene glycol modified gum	Acetylated gum
Moisture Content (%)	9.75±0.45	9.95±1.20	9.90±1.55
pH	6.83±1.25	6.22±1.50	7.10±1.45
Swelling Index	6.06±0.44	4.49±0.34	6.13±1.07
Water Hydration Capacity (g/10g)	108.82±3.05	99.61±4.97	122.99±8.9
Viscosity (mPas)	530.8±0.98	300.6±1.78	364.8±2.25

DISCUSSION

A total yield of 44% native gum was obtained from the gum exudate of Enterolobium cyclocarpum tree. This is yield is considered to be high (Pant et al., 2015; Ebere et al., 2012).

A high moisture content of 9.75% was obtained for the native gum and there was no significant difference in the moisture contents of the modified gums (Table 2). These values agree with the values reported for gums of Nigerian Cashew plant and Tamarind seed (Patil, 2014; Ebere et al., 2012). There is therefore need for caution when Enterolobium gum is used in formulations containing certain drugs that are highly moisture sensitive.

Table 3:
Properties of Chlorpheniramine Films Containing Enterolobium Gum/HPMC blends (mean± s.d. n=3)

Formulation	Thickness(mm)	Weight variation(mg)	Folding endurance	pH	Disintegration time(sec)
HPMC	0.16±1.5	55.13±1.9	77±1.9	5.60±1.2	66.00±2.7
NG4/HP1	0.17±2.2	50.25±3.5	45±2.9	5.02±2.0	130.00±5.5
NG3/HP2	0.22±1.2	48.11±5.9	51±2.5	5.27±3.5	88.00±2.2
NG2/HP3	0.14±4.2	43.24±6.6	48±1.2	5.77±1.5	65.00±3.5
EG4/HP1	0.21±2.3	44.33±6.6	46±2.8	5.50±4.5	145.00±2.8
EG2/HP3	0.18±5.3	62.75±2.5	72±3.5	5.77±5.2	84.00±6.5
AG4/HP1	0.15±1.2	47.38±6.2	62±1.0	5.68±2.5	160.00±3.5
AG3/HP2	0.19±1.3	65.73±6.4	79±7.5	5.58±2.8	72.00±7.5
AG2/HP3	0.21±2.5	69.95±4.3	92±1.2	5.42±6.5	120.00±7.4

Furthermore, at optimal temperature in the presence of moisture, the shelf life of most routine formulations can be reduced since such conditions favour activation of enzymes and proliferation of microorganism. High value of moisture content could also promote deterioration of a natural product by hydrolysis. (Emeje et al.,2009; Chukwuemeka et al., 2012). However, the high moisture content of the gum could be an advantage when the gum is utilized as a disintegrant and/or bioadhesive excipient in drug formulations.

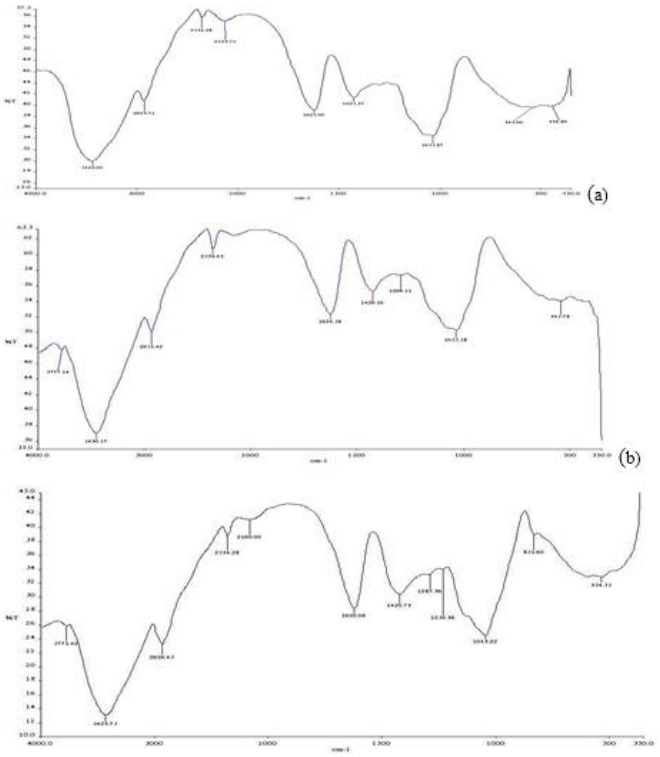

Figure.1
(a) FTIR of Native Enterolobium gum (b) FT-IR of Ethylene glycol modified Enterolobium gum (c) FT-IR of Acetylated Enterolobium gum

The native gum showed a swelling index of 6.06% (Table 1). Modification by ethylene glycol significantly reduced the swelling index while acetylation had no significant effect. Swelling refers to taking up of a liquid with a consequent increase in volume. The extent of swelling in polymers has been shown to be a competition between the free energy of mixing, which makes the solvent penetrate in an attempt to dilute the polymer solution and the elastic retractile force which opposes the deformation (Ayorinde et al., 2016). The high values of swelling index in the native and acetylated gums indicate that the gums could be more easily penetrated by water.

Swelling property is important in tablet formulations where the tablets need to take up water, swell and disintegrate in order to release the contained API, furthermore, the mechanism of swelling has proved to be capable of producing a force that leads to tablet disintegration (Guyot-Herman, 1992; Adedokun et al., 2014). Hence native and acetylated forms of Enterolobium gum could be useful excipients in tabletting while modification by ethylene glycol could be considered when the gum is needed in other dosage forms where swelling is not a critical requirement.

The high viscosity obtained for the native gum (Table 2) agrees with our earlier work on solid state characterization of Enetrolobium and Cederela gums (Ayorinde and Odeniyi, 2017). However, the two modification methods significantly reduced the viscosity of native Enterolobium gum. Viscosity is a measure of resistance to deformation by shear or tensile stress or flow and a high viscosity in polymers indicates the presence of high internal friction which could result to a high resistance to flow Sanchez et al., 2002). Results therefore indicate the possibility of reducing the high viscosity of the gum by acetylation or ethylene glycol modification

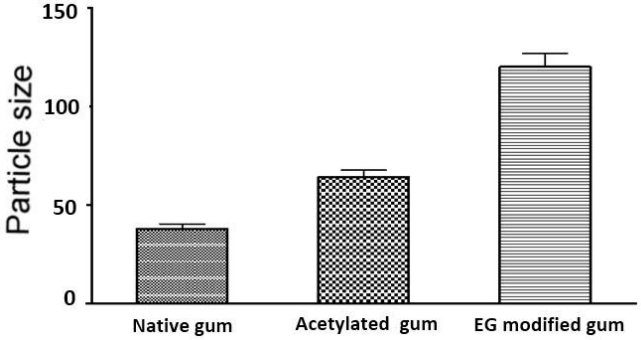

Figure 2
Mean particle size of Native and Modified Gums. EG= Ethylene glycol

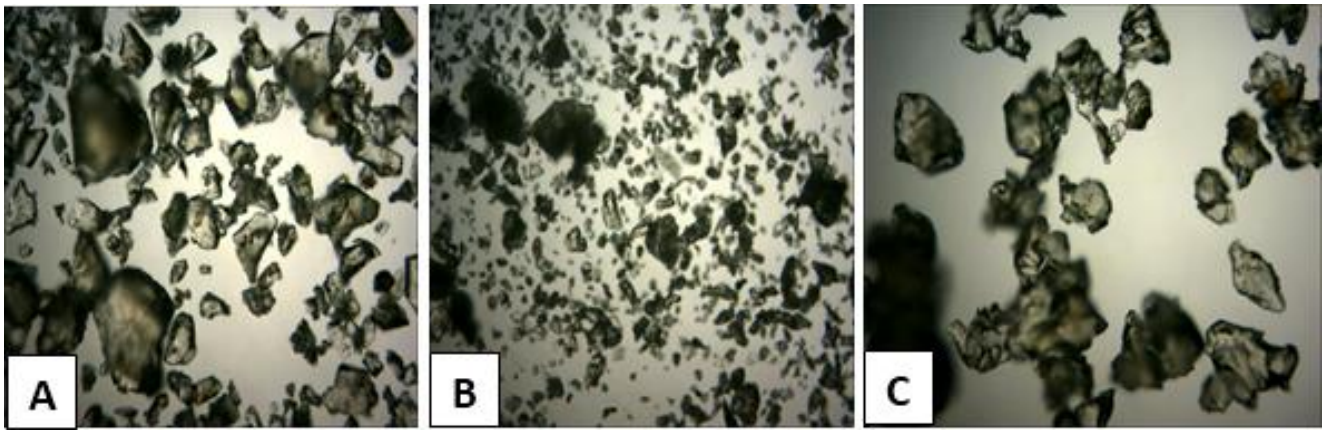

Figure 3
Photomicrograph of (a) Native Gum (b) Acetylated Gum (c) Ethylene Glycol Modified Gum

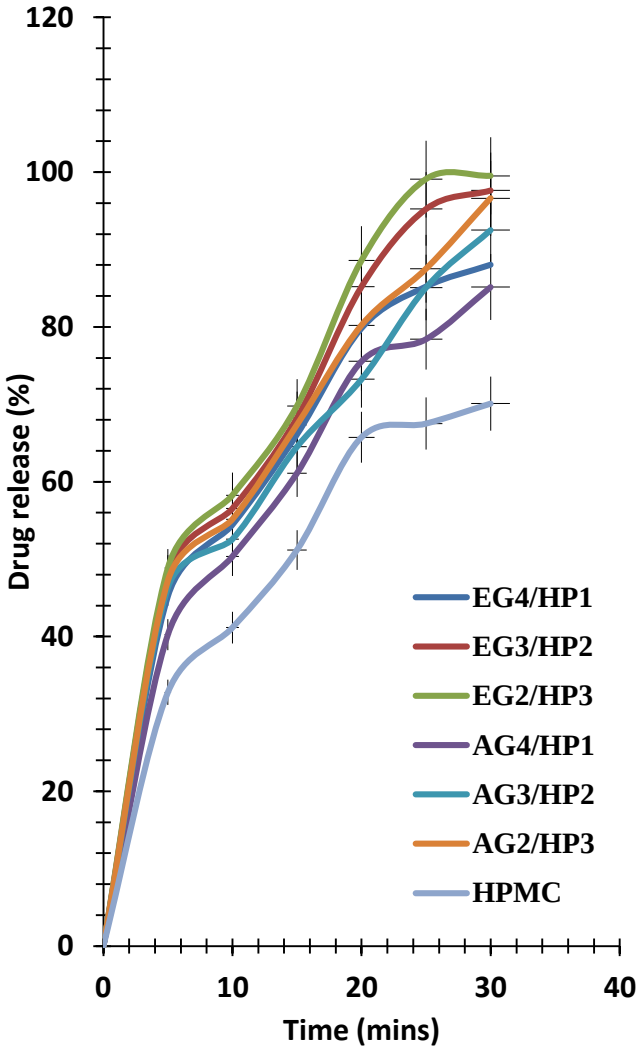

Figure 4:
Drug Release Profile of Chlorpheniramine Oral Dissolving Films Formulations

This could be necessary in the formulation of liquid dosage forms where too high viscosity may tend to affect pouring from bottles.

The pH is a parameter that could be used to determine suitability of a polymer for use in formulations that comes in contact with mucous membranes. Oral dissolving films stick with buccal mucosal and are expected to be of neutral pH, so as not to impart any form of mucosal irritation (Ayorinde et al., 2016). Values of pH for the gums are presented in Table 2. The native gum had a pH that is close to neutral. Modification by acetylation was found to bring the pH of the gum to 7.10, while ethylene glycol modification slightly increased the acidity of the gum. The results suggests that the gum is of near neutral pH and acetylation further increase the neutrality of the gum, making it suitable for formulation of oral dissolving films. The buccal cavity has been found to be irritated by extreme pH of a drug product (Nitesh et al., 2012). However, in situations where an acidic gum is desired, ethylene glycol modification could be considered for Enterolobium gum.

The functional groups present in native and modified gums are shown in the FT-IR spectra (Fig. 1a-c). There was no major shifting and appearance of any new prominent characteristic peak as a result of the API. This indicates absence of adverse interaction between the API and the gums. Each of these spectra show broad, smooth yet intense absorption peak at 3442cm-1 which indicates the presence of –OH functional group. The weak peak at 2925 - 2935cm-1 and 2354 cm-1 as seen in all spectra of each of the gums represents CH2-CH2(Symmetric bonding) (Pant et al., 2015; Pavia et al., 2001). The intense vibrational peak seen between 1035 cm-1 and 1045 cm-1 indicates C-O and C-OH bond associated with carboxylate of some acidic sugars (Eddy et al., 2014). Band 1624cm-1 is attributable to a C=O stretch of an aldehyde. This is especially so since the presence of the C=O stretch did not obscure the CH2-CH2 peak earlier identified. These peaks are obtainable for a polysaccharide compound such as gums. Many polysaccharides have aldehyde functional groups with characteristic poly hydroxyl groups. The weak, narrow peak at the 3771cm-1 is present only in the spectra of the modified gums (Fig. 1b and 1c). This peak can qualify for an amine and since none of the methods introduced an amine group to the gum, it appears that the amine group is present in the native gum as tertiary amine, R3N, a form that gives no peak but likely converted during modification to the secondary amine seen in the acetylated and ethylene glycol modified gums (Stuart, 2004). Thus native gum contains tertiary amine which is likely reduced during gum modification to R2N-H (di-substituted). This observation supports the percentage of nitrogenous content of the proximate analysis of the native gum. Acetylation is seen by presence of important ester band at 1230 cm-1 in Fig. 3 as well as the reduction in the values for the peak for the OH from 3450 cm-1 to 3425 cm-1 (Ayoub et al., 2013).

The particle size distribution of the gum and photomicrographs of the samples are presented in Figures 2 and 3 respectively. Ethylene glycol modified gum was found to have the largest particle size while the native gum had the smallest; the ranking was EG > AG > NG. This suggests that the modification methods increased particle size of Enterolobium gum. Photomicrographs of the gum further showed that the modified gums had pores and aggregating while the native gum was shown to be made up of non-porous and non-adhering particles. The increase in size of the modified gum could therefore be attributed to the pores and the adhering particles.

The mechanical strength of the films as reflected in the folding endurance is shown in Table 3. The folding endurance of films prepared with only HPMC was found to be significantly higher than formulations from NG/HPMC blends. Films prepared from AG/HPMC blends had comparable mechanical strength with HPMC formulations. The rank order in term of mechanical strength of film formulation is HPMC > AG/HPMC > EG/HPMC > NG/HPMC. These results suggest that gum modification by acetylation is capable of producing films whose mechanical strength is comparable to films prepared with HPMC and better than films produced from the native gum. Acetylation thus conferred a better mechanical strength on the films. This

could be attributed to the improved entanglement of the acetylated gum with HPMC. Entanglement with consequent improved mechanical property for film has been reported by Kumar et al. (2013).

The disintegration time for the films ranged from 66 – 160seconds, with HPMC films having the shortest disintegration time of 66seconds (Table 3). Generally, in all the film formulations, the disintegration time reduced with increasing concentration of HPMC in the blends. Although no official disintegration time has been stipulated for oral dissolving films, some published works have documented less than 60 seconds to be ideal for immediate release of active ingredient (Choudhary et al., 2011; Ayorinde et al., 2016). However, none of the formed films met with the disintegration time of less than 60 seconds stated in the literatures. A short disintegration time was expected, due to the high swelling index obtained for the gums; however, the high disintegration time obtained is attributable to the reported plastic nature of enterolobium gum. More so, that disintegration time has been described as a function of the composition of the film (Ayorinde et al., 2016). The use of a surfactant and disintegrant such Poloxamer and Carboxy methyl cellulose (CMC) respectively has been reported to improve the rate and degree of wettability of the film and subsequently its disintegration (Muhammad et al., 2015; Kumar et al., 2013).

A comparable release profile was obtained for films prepared with HPMC and NG/HPMC blends, while better release was shown by the blends prepared with modified gums (Fig.4). At 30minutes, the rank order in percentage drug release from the formulations is EG/HPMC > AC/HPMC > NG/HPMC > HPMC. Results therefore suggest that modification of Enterolobium gum is capable of improving the drug release profile from film formulations. Furthermore, there appeared to be an optimum concentration of the gum and HPMC in the blends, at which the best release profile could be obtained; generally, at ratios of 2:3 and 3:2 of gum/HPMC, release of 93 – 99% was obtained from the films. This indicates that optimum concentrations of the modified gums are needed to produce films with excellent profiles. The dissolution profile of a film is affected by its complete disintegration, influx of dissolving fluid and resulting increase in area to volume ratio of the film and has been found to be very essential because it goes a long way in determining the bioavailability absorption of the drug from the dosage form (Arya et al., 2010; Ayorinde et al., 2016).

In conclusion, physicochemical properties of Enterolobium gum was improved by both acetylation and ethylene glycol modifications. Oral dissolving films of acceptable qualities were produced from native and modified Enterolobium gums. Blends of the gum with HPMC at the ratios of 3:2 and 2:3 produced films with highest drug release. Furthermore, films produced with ethylene glycol modified gum had the best drug release profile.

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