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Research Article

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Acacia cumanensis plant gum as release retardant in matrix tablet formulation taking Aceclofenac as model drug

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ABSTRACT

The present work was aimed to explore the release retarding properties of *Acacia cumanensis* plant gum in matrix tablets using Aceclofenac as model drug. Physicochemical properties of dried powdered *Acacia cumanensis* plant gum were studied. Various formulations of Aceclofenac *Acacia cumanensis* gum were prepared. The prepared tablets were evaluated for physicochemical properties, swelling index, drug release. The prepared tablets were found to have better uniformity of weight, swelling behavior and drug content and release characteristics. The study concluded that *Acacia cumanensis* plant gum can be used as a matrix forming release retardant in once daily sustained release matrix tablets.

Key words: Aceclofenac, Acacia *cumanensis*, matrix tablets, release retardant

INTRODUCTION

Aceclofenac is a non-steroidal anti-inflammatory drug (NSAIDs), which is commonly used in the long-term therapy for rheumatoid arthritis. The biological half-life of Aceclofenac is about 4 h; therefore it requires multiple dosing to maintain therapeutic drug blood level. The most frequent side effects of Aceclofenac on long-term administration are gastrointestinal disturbances, peptic ulceration and gastrointestinal bleeding. Aceclofenac is poorly soluble in water but is rapidly soluble in alcohol [1]. Hence an attempt was made to formulate a sustained release formulation with increased patient compliance and decreased signs of adverse effects [2]. *Acacia cumanensis* (*Fabaceae* family) is a small weed plant grows all over the world [3]. The tree grows to a height of up to 12 m and has a trunk with a diameter of up to 1.2 m. The plant has characteristic thorns and yellow flowers. The bark exudates a good amount of gum round the year. The objective of present investigation is to explore the release retarding property of *Acacia cumanensis* gum in matrix tablets taking Aceclofenac as a model drug.

MATERIALS AND METHODS

Materials

Aceclofenac was obtained as a gift sample from Walkman Selman Laboratories, Anantapur, India. *Acacia cumanensis* gum was collected from plants growing in local areas of Anantapur, India. The plant was authenticated at the Department of Pharmacognosy, Balaji College of Pharmacy, Anantapur, India and voucher specimen number was obtained (BCP/PCOG 29) and preserved in the herbarium of Department of Pharmacognosy, Balaji College of Pharmacy, Anantapur, India. Micro crystalline cellulose (Avicel) and Magnesium stearate were procured from SD Fine chemicals (Mumbai, India). All other chemicals used were of analytical reagent grade and double distilled water was used throughout the experiments.

Methods

Extraction of gum

The *Acacia cumanensis* gum was collected and soaked in water for 5–6 h, boiled for 30 minutes and left to stand for 1 h to allow complete extraction of the gum into the water. The gum was filtered using a multi-layer muslin cloth bag to remove the dirt and foreign matter from the solution. Acetone (in the quantities of three times the volume of filtrate) was added to precipitate the gum. The gum was separated, dried in an oven at 35°C, collected, ground, passed through a # 80 sieve and stored in desiccator at 30 °C & 45% relative humidity till use. This gum was tested for flow properties [4, 5].

Preparation of Matrix Tablets

Table 1: Formulae of *Acacia cumanensis* gum –Aceclofenac matrix tablets

Ingredients (mg)	**Formulations**				
	AA-1	**AA-2**	**AA-3**	**AA-4**	**AA-5**
Aceclofenac	200	200	200	200	200
Acacia cumanensis gum (dried)	50	100	150	200	250
Micro crystalline cellulose (Avicel)	245	195	145	90	45
Magnesium stearate	5	5	5	5	5
Total weight of tablet	500	500	500	500	500

The matrix tablets of Aceclofenac with *Acacia cumanensis* gum were prepared by using different drug: gum ratios viz. 1:0.25, 1:0.50, 1:0.75, 1:1.00 and 1:1.25. Different tablet formulations were prepared by direct compression technique and the formulations were named as AA-1, AA-2, AA-3, AA-4 and AA-5 respectively (Table 1). All the powders were passed through sieve #80. Talc and magnesium stearate were finally added as lubricants. The drug and powdered gum were compressed (10 mm diameter, biconvex punches) using a single-punch tablet compression machine (Cadmach, Ahmedabad, India).

EVALUATION

Evaluation of Powdered Gum

Angle of Repose

The angle of repose of powdered gum was determined by the funnel method. The accurately weighed granules were 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 heap of the granules. The granules were allowed to flow through the funnel freely onto the surface. The diameter of the powder cone was measured and angle of repose was calculated using the following equation [6].

$$\theta = \tan^{-1} (h/r)$$

Where h and r are the height and radius of the powder pile respectively

Bulk Density

Both loose bulk density (LBD) and tapped bulk density (TBD) were determined. A quantity of 2 g of powder from each formula, previously lightly shaken to break any agglomerates formed, was introduced into a 10 ml measuring cylinder. After the initial volume was observed, the cylinder was allowed to fall under its own weight onto a hard surface from the height of 2.5 cm at 2 sec intervals. The tapping was continued until no further change in volume was noted. LBD and TBD were calculated using the following formulas [7].

LBD = Weight of the Powder/Volume of the packing
TBD = Weight of the powder /Tapped volume of the packing

Compressibility Index

The compressibility index of the gum powder was determined by Carr's compressibility index.

Carr's Index (%) = (TBD – LBD)/TBD X 100

Drug Content

Table 2: Physical properties of *Acacia cumanensis* gum Aceclofenac matrix tablets

Sl. No	Formulation	Thickness (mm)	Hardness (Kg/cm^2)	Friability (%)	Drug content (%)
1	AA-1	9.9±0.26	7.80±0.5	0.80±0.06	99.9±6.54
2	AA-2	9.9±0.14	8.10±0.5	0.65±0.05	100.2±2.24
3	AA-3	9.8±0.05	7.50±0.5	0.78±0.05	100.5±5.80
4	AA-4	9.4±0.15	8.90±0.5	0.85±0.04	99.9±6.84
5	AA-5	9.5±0.61	6.50±0.5	0.75±0.05	99.8±4.51

All values were mentioned in mean ±SD; Number of trials (n) = 5

An accurately weighed amount of powdered matrix tablets (500 mg) was extracted with water and the solution was filtered through 0.45µ membrane (Nunc, New Delhi, India). The absorbance was measured at 277 nm after suitable dilution. The above physical properties of formulated matrix tablets were shown in Table 2.

Evaluation of Tablets

Thickness

The thickness of the tablets was determined using a thickness screw gauge (Mitutoyo, New Delhi, India). Five tablets from each batch were used and average values were calculated.

Uniformity of Weight Test

To study weight variation, 20 tablets of each formulation were weighed using an electronic balance (Denver APX-100, Arvada, Colorado) and the test was performed according to the official method [8].

Hardness and Friability

For each formulation, the hardness and friability [9] of 10 tablets were determined using the Monsanto hardness tester (Cadmach, Ahmedabad, India) and the Roche friabilator (Campbell Electronics, Mumbai, India), respectively.

Estimation of Aceclofenac:

An ultraviolet spectrophotometric method based on measurement of absorbance at 277 nm in alkaline borate buffer of pH 7.4. The method obeyed Beer-Lambert's law in the concentration range of 1-20 µg/ml. When a standard drug solution was assayed for 6 times, the accuracy and Precision were found to be 0.98% and 1.16% respectively. No interference was observed from the excipients used.

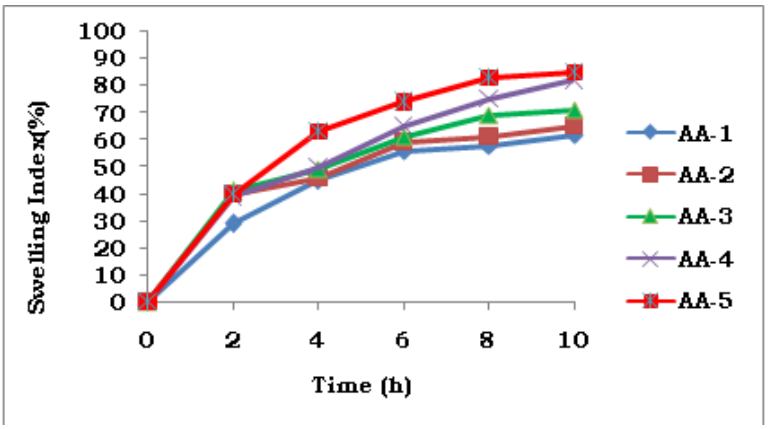
Swelling behavior of Sustained release matrix tablets

The extent of swelling was measured in terms of % weight gain by the tablet. The swelling behavior of formulations AA-1, AA-2, AA-3, AA-4 and AA-5 were studied. One tablet from each formulation was kept in a Petri dish containing pH 7.4 phosphate buffer [10]. At the end of 1 h, the tablet was withdrawn, kept on tissue paper and weighed then. This procedure was repeated till 12 h. The % weight gain by the tablet was calculated by the following formula.

$$S.I = \{(M_t - M_0) / M_0\} \times 100$$

Where, S.I = swelling index, M_t = weight of tablet at time't' and
M_o = weight of tablet at time t = 0. Swelling behavior of sustained release matrix tablets were represented in fig. 1.

Fig.1. Swelling Index of *Acacia cumanensis* gum Aceclofenac matrix tablets



IN-VITRO RELEASE STUDIES

The *in vitro* dissolution studies were carried out using USP apparatus type II (Tab-Machines, Mumbai, India) at 75 rpm. The dissolution medium consisted phosphate buffer pH 7.4 for 12 h (900 mL), maintained at 37°C ± 0.5°C. The drug release at different time intervals was measured by UV-visible spectrophotometer (Systronics UV spectrophotometer-117, Mumbai, India) at 277 nm [11] using Chemstation software (Agilent Technologies, New Delhi, India). It was made clear that none of the ingredients used in the matrix formulations interfered with the assay. The release studies were conducted in triplicate (6 tablets in each set) and the mean values were plotted versus time with SDs of less than 3, indicating the reproducibility of the results.

RESULTS AND DISCUSSION

Infrared Spectrum of Aceclofenac pure drug, Infrared Spectrum of *Acacia cumanensis* graphs indicate there are no negative interactions between drug and matrix material used. Matrix tablets, each containing 200 mg of Aceclofenac, were prepared using dried gum of *Acacia cumanensis* in various drug: mucilage ratios (1:0.25, 1:0.50, 1:0.75, 1:1.00 and 1:1.25). Among these formulations, the release rate was increased in the following order: AA-1 > AA-2 > AA-3 > AA-4 > AA-5. To know the mechanism of drug release from these formulations, the data were treated using zero order and first order Model were shown in figures 2 and 3 respectively.

The kinetic plots were perfectly fitting to the formulated *Acacia cumanensis* gum- Aceclofenac matrix tablets. This result has shown that as the proportion of *Acacia cumanensis* gum increased, the overall time of release of the drug from the matrix tablet was also increased. Drug releases from matrix tablets were by drug dissolution, drug diffusion or a combination of both.

Fig.2. Zero order release Plots of formulated matrix tablets

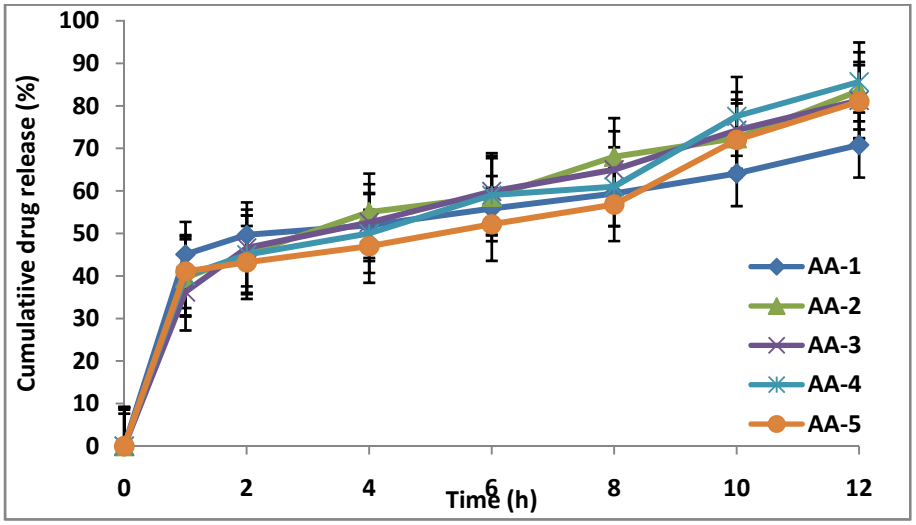
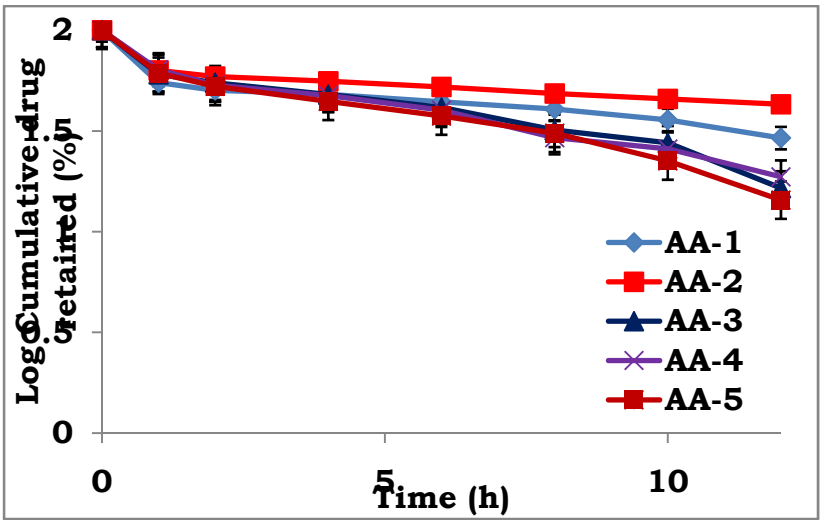


Fig.3. First order release Plot s of formulated matrix tablets



CONCLUSION

The present study revealed that *Acacia cumanensis* gum appears to be suitable for use as a release retardant in the manufacture of once daily sustained release matrix tablets because of its good swelling, good flow and suitability for matrix formulations. From the dissolution study, it was concluded that dried *Acacia cumanensis* gum can be used as an excipient for making once daily sustained release matrix tablets.

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