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Evaluation of modified Guar Gum as film coating material

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Abstract: Guar gum produces films that lack in clarity and have poor tensile strength. Hence guar gum was modified chemically for improving its film forming properties. The derivatives were evaluated as film coating material by coating dummy tablets. To take the advantage of both solvent and aqueous coating processes and overcome their limitations, a combined coating formulation was developed comprising the major portion of solvent as water and minor portion of solvent as isopropanol. This combination of solvents improved the drying rate which is the most critical parameter in aqueous film coating. The coated tablets were studied for various tablet parameters such as hardness, friability loss, film adhesion and disintegration. Accelerated stability studies were carried out at 40^0C and at 75 % relative humidity for period of 6 months.

Key words: Guar gum, Tablet coating.

Introduction

Film coatings are applied to pharmaceutical dosage form to protect them against the environment, to improve their appearance, to mask undesirable test or odor, to impart enteric properties and to modulate release of medicaments[1]. Since its inception, the film coating of pharmaceutical dosage form has shown significant increases in popularity, owing to the many advantages it has to offer. Film coating has been studied extensively in the pharmaceutical industry and the use of polymer has been widely accepted[2]. The main polymers used for film formation have been classified in three categories: Gastro soluble, Gastro resistant (enteric) and insoluble[3]. The most important raw material for film coating is a pharmaceutically acceptable film forming resin which should form a coherent film on the surface of the substrate under the prevailing conditions[4]. The film forming potential of guar gum has been evaluated by Baweja and Misra[5]. Guar gum, a natural polysaccharide has a cis-hydroxyl group in its structure that can be modified to prepare specially reagent like product of low viscosity[6]. Solvent costs, environmental pollution and operator safety have driven the move from organic solvents to aqueous film coating. But the replacement of organic solvents has increased the complexity of process. So to take the advantage of both solvent and aqueous coating processes and overcome their limitations , a combined coating formulation was developed comprising the major portion of solvent as water (7 parts) and minor portion of solvent as isopropanol (3 parts) this combination of solvents improves the drying rate which is the most critical parameter in aqueous film coating.
Guar gum being of natural origin, guar derivatives are expected to be ecofriendly and biodegradable. The present work deals with evaluation of newly synthesized guar derivatives as film coating material.

Materials and Method

Material

Guar gum I.P. (S.D fine chemicals Mumbai, India) PEG.-400 (S.D fine chemicals Mumbai, India) Glycerine I.P. (S.D fine chemicals Mumbai, India) Isopropanolol (S.D fine chemicals Mumbai, India) Lactose (E.merk ,mumbai,India).

Methods

Tabletting and Coating of Tablets
Tabletting :-Dummy tablets were prepared on a single stroke compression machine, using lactose, starch 10%, magnesium stearate 1%, talc 1%, by weight per tablet, with following specifications
Description:Thickness:- 4.10 mm
Avg. weight of tablet:- 250 mg Friability loss:- 0.4%
Hardness ;- 3 Kg/cm^2

Table 1 : Operating conditions for coating

Item	Conditions
Charge per batch	20 tablet
Speed of pan revolution	30 rpm
Distance of spray gun	5 cm
Spray gun nozzle diameter	0.5 mm
Spray rate	1ml/min
Temperature of coating dispersion	Room temperature
Drying air temperature	60-70^{0}C
Tablet bed temperature	60^{0}C
Coating time	4 h

Coating Formulation

The coating dispersion consisted of 1gm coating material (guar gum, MG1, MG2). PEG-400 [20%w/w of total solid content) and mixture of water and isopropanol in proportion of 7:3. This coating formulation was evaluated for contact angle and viscosity.

Contact angle

The contact angles between the coating solution of tablets were determined by the sessile drop method, placing small droplets (volume 10 µl) on the tablets. The height of the droplet and the width of the base of the droplet were measured[7] .

Viscosity

Viscosity of the coating formulation was determined using Brookfield viscometer.

Table 2: Results of contact angle

Coating solution	Contact angle
GG	50^0
MG1	52^0 15
MG2	48^0 36

Table 3: Results of viscosity

Coating solution	viscosity (cps)
GG	80
MG1	15
MG2	14

Coating Procedure

The small coating pan of glass (250 ml) was used for coating. Both coating assembly and coating procedure were modified to suit the requirements of aqueous coating. An electric hot plate was placed below the coating pan at a distance of about 5 cm to heat the tablet bed upto temperature of 60-70^{0}C, which helped in rapid drying of the film. For the first three coats, the coating solution was spread with the help of spray gun (aerostar) for a short period and the coating was dried by blowing hot air intermittently on to a rotating tablet bed (drying period 15-20 min.) in the subsequent coating, the spraying time of coating solutions was increased to 10-15 seconds and drying time was reduced to 5-10 min. This manipulation in the coating process was essential to avoid the migration of water from coating solution into the core.[8.] The operating conditions employed for coating are shown in table 1.

Evaluation of Coated Tablet

Coated tablets were evaluated for the parameters affected by coating e.g. surface morphology, thickness, hardness, friability, disintegration and film adhesion.

Film thickness of coated tablet was determined by measuring the change in dimensions (crown thickness and diameter) after coating of tablets. Hardness of the tablet was measured with Monsato tablet hardness tester. It measures the pressure required to fracture the diametrically placed tablet by applying the force with two plungers and coiled spring. Friability loss was measured with Roche Friabilator. The adhesion of the polymer film was measured as the force required to remove the film from the tablet surface, using a specially designed tensile testing apparatus[7].

Stability testing

Stability of coating material was determined by exposure of coated tablets to 40^{o}C and 75 % relative humidity for 6 months , testing periodically for change in appearance, weight, hardness friability and disintegration**.**

Results and Discussions

In the present article, two new derivatives of guar gum (MG1 & MG2) are synthesized and evaluated for their properties.The contact angles between the coating solution and tablet cores are shown in Table 2. According to Wenzel[9] , polymer solution spreads more readily when the tablet surface is rough; the contact angle decreases with increasing roughness of tablets. The coating solution was less Viscous due to the replacement of water in part with isopropyl alcohol.

Evaluation of Coated Tablets

Uniform and continuous coat, free of surface defects was obtained. The coated tablets possessed smooth and clear boundaries particularly at the edges indicative of uniform coating it is thus evident that the coating formulation, process condition and application procedure were all in order.

Results of Hardness, friability, disintegration and film adhesion are shown in table 4. MG2 coated tablet shows comparatively good physical properties than guar gum and MG1 coated tablet. It is expected that the film adhesion to tablet surface increases with a decrease in the contact angle. Fisher and Rowe[10] found that adhesion with low viscosity organic based film coating solutions was higher than that with high viscosity solution. With high viscosity solutions the effective area of contact will be lower, resulting in lower adhesion values.

From the stability studies, it was observed that there were negligible changes in physical properties over the study period establishing that MG1 and MG2 were stable against selected environmental conditions.

Conclusion

In the present study, the film coating properties of two new modified guar gum MG1 & MG2 have been investigated to asses their potential for use in film coating. Both MG1 and MG2 could be used as film coating agents at concentration of 1 % w/v in a 3:7 mixture of isopropanol and water with addition of PEG – 400 (20% total solid content). MG2 shows comparatively best result than MG1. The modified guar gums therefore promise considerable utility in film coating and in the design of gastroresistant delivery dosage form.

Table 4: Evaluation of coated tablet

Coating material	Film thickness (mm)	Hardness (kg/cm^2)	Friability (%)	Disintegration (min)	Film Adhesion (g)
GG	0.08	5	0.06	45	11.92
MG1	0.07	5.5	0.06	50	10.76
MG2	0.08	6	0.05	55	12.85

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