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Short Communication

The Effect of Core Surface Tension on Roughness of Film – Coated Tablets

Soheila Honary [a]*, Hossein Orafai[b]

[a]*School of Pharmacy, Mazandaran University of Medical Sciences and Health Services, Sari, Iran.* [b]*School of Pharmacy, Mashhad University of Medical Sciences and Health Services, Mashhad, Iran*

Abstract

The arithmetic mean roughness, R_a, values were determined by scanning electron microscopic technique of different core models (furazolidone, nitrofurantoin and acetyl salicylic acid), coated by HPMC film forming solution containing 10 wt% of various molecular weight PEGs. The results showed that both plasticizer molecular weight and core surface free energy could have a significant influence on R_a.

Keywords: Film coating; Plasticizer molecular weight; Surface free energy; Arithmetic mean roughness.

Introduction

Film coating technology has precedents in both paints and adhesives technology. It is a field of applied science with specific background such as polymer, materials and polymer sciences. Tablets are film–coated for many reasons such as protection of the tablet core against environmental factors, regulation of drug release in body and identification of drug and masking the unpleasant taste. Several workers have performed extensive experiments and applied methods to investigate factors affecting film roughness (1). Rowe investigated the effect of some formulation and process variables on the surface roughness of film coated tablets and reported that tablets with rough surface could be prepared by coating with low molecular weight grades of HPMC and that an increase in the polymer concentration above 2 wt% caused an increase in the roughness (2). The behavior of film coating droplets on their impingement onto uncoated and coated tablets was studied by Twitchell and his coworkers (3). They showed that the droplet viscosity and momentum are important in governing the penetration behavior and their spreading on the surface of uncoated and coated tablets. Most of the researches have been focused on the properties of film coating solution and different additives (4). The aim of this work was to study the effect of core properties, specially core surface tension on film roughness.

* Correspoding author:
E-mail: shonary@yahoo.com

Experimental

Materials

Metocel E5 (HPMC) was purchased from Colorcon, Ltd (UK). Polyethylene glycol (PEG) 300, 600, 1500 and 4000 were purchased from Merck Company (Germany). PEG 400 was provided from Sigma Chemical Company (UK). Furazolidone, nitrofurantoin, and acetyl salicylic acid were purchased from Ubichem (England), Tokyo Tonabe (Japan) and Beyer (Germany), respectively.

Core preparation

Additive – free powders were pressed by an IR Jack at 4-tone pressure and flat–faced 8 mm and 5 cm punches. Disks with 5 cm diameter were used for contact angle measurements (5), determined by measuring the maximum height of a drop of various liquids on the prepared disks. Surface tension and polar-nonpolar dispersion forces were calculated by Wu and Fuces equations, using a computer program.

Table 1: Surface energy component of core models (mJ).

	γ_T	γ_d	γ_p
Nitrofurantoin	52.84	24.23	28.63
Furazolidon	48.31	25.46	22.85
Acetyl salicylic acid	54.19	24.26	20.95

Preparation of solutions

Solutions were prepared with known concentrations of HPMC and different plasticizers. The plasticizer concentration was kept constant at 10 wt% of HPMC. Film coating process was performed based on the previous work (6). The solutions were sprayed on the cores for 3 seconds for 20 minutes and samples were then dried at 40°C for 10 minutes after each spraying. Surface of three cross sections for each sample was coated by a thin layer of gold in a vacuum evaporator and the micrographs were taken by scanning electron microscope model 2300 (Leo Oxford, UK) in order to measure the arithmetic mean roughness, R_a, values.

Results and Discussion

Measurement of contact angles may provide useful information and assists in the understanding and prediction of film adhesion, droplet spreading and penetration tendencies and any possible interactions between the constituents of the coating formulation and substrate. Table 1 shows the surface tension and polar–nonpolar dispersion forces from different core models. Plotting R_a for different core models (furazolidone, nitrofurantoin, acetyl salicylic acid) against different molecular weight plasticizers showed that R_a increased significantly ($p < 0.05$) as the molecular weight of PEG increased (Figure 1). This can be explained by considering this fact that there will be more molecules and, therefore, presumably more activity and plasticity of films per gram of added PEG, such that the least film coat was obtained by using smaller molecular weight plasticizers (PEG 300 , 400). Plotting R_a against surface free energy of cores showed that the surface

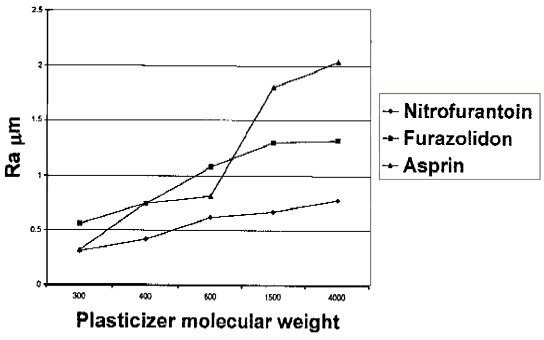

Figure 1. The effect of plasticizer molecular weight on film roughness.

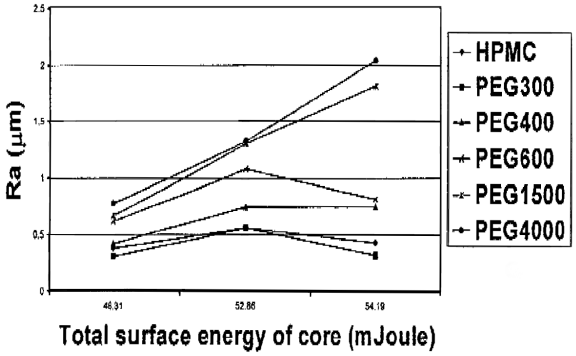

Figure 2. The effect of core surface energy on surface roughness.

roughness increased as the core free energy raised (Figure 2). It could be seen that this increase was occurred in all coated formulations with 10 wt% of different plasticizers from 48.31 to 52.86 mJ of core total surface energy. Ra increased by using high molecular weight PEGs (1500 and 4000) and decreased by using PEG 300 and 400. The coating contact angles formed by droplets on a substrate during aqueous film forming and their spreading behavior may potentially influence the roughness and appearance of coated products. This effect could be explained by the similarity of coating solution and core surface tension. According to these results, it is useful to employ surfactants in order to reduce the surface tension of the solution and film coat roughness.

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References

(1) Twitchell AM, Hogan JE and Aulton ME. Assessment of the thickness variation and surface roughness of aqueous film coated tablets using a light-section microscopy. *Drug Delivery and Industrial Pharmacy* (1995) 1611-1619

(2) Rowe RC. The effect of some formulation and process variables on the surface roughness of film coated tablets. *J. Pharm. Pharmacol.* (1978) 669 – 672

(3) Twitchell AM, Hogan JE and Aulton E. The behavior of film coating droplet on their impingement onto uncoated and coated tablets. *S.T.P. Pharma Science* (1995) 190-195

(4) Augustin OO, York P. The effect of particle size of an inert additive on the surface roughness of a film coated tablet. *J. Pharm. Pharmacol.* (1981) 33: 1-4

(5) Fell JT and Fenatiks E. The wetting of acetyl salicylic acid, salicylic acid, phenacetin and paracetamol. *J. Pharm. Pharmacol.*(1978) 30: 538 – 541

(6) Honary S, Orafai H and Shojaei A. The influence of plasticizer molecular weight on spreading droplet size of HPMC aqueous solution using an indirect method. *Drug Develop. Ind. Pharmacy*. (2000) 26: 1025-1030