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COMMUNICATION

THE EFFECTS OF DIKA FAT (A NEW TABLET LUBRICANT) ON THE PLASTO-ELASTICITY OF SOME PHARMACEUTICAL POWDERS

S. ESEZOBO

Department of Pharmaceutics & Pharmaceutical
Technology, School of Pharmacy,
College of Medical Sciences,
University of Benin,
Benin City.
NIGERIA.

ABSTRACT

Measurements have been made of the effects produced on the "plasto-elasticity" ratio, ER/SR, tensile strength and disintegration of Sta-Rx, Emcompress and lactose as a result of adding increasing amounts of dika fat and stearic acid respectively to the powders and compressing to form tablets. Increase in their proportions caused an increase in the ER/SR raio but decreased the tensile strength and disintegration rate of the resulting tablets. The powders containing dika fat exhibited marginally higher ER/SR ratio values but its tablets had lower tensile strengths and shorter disintegration times than tablets containing stearic acid. The tensile strength of the tablets was found to be inversely proportional to ER/SR.

INTRODUCTION

The ability of formulated powders to form satisfactory tablets depends on their plastic deformation during compression and on their elastic recovery

during decompression (1, 2). Besides a number of experimental variables - eg compression rate, the duration of the maximum compression and the magnitude to the applied load - which affect the extent to which elastic and plastic deformations occur during the compression of powders, it has recently been shown (3 - 6) that the addition of the excipients: microcrystalline cellulose and lubricants to pharmaceutical powders also have the ability to modifty the plastic and elastic characteristics of the powders.

Dika (Irvingia gabonensia, var excelsia) is a tropical plant which grows abundantly in the Southern part of Nigeria. The fat extracted from the kernels of the plant is used extensively for food by the natives (8). The fat is solid at room temperature (mp 39 - 40^{o}C) and its fatty acids content is well known (9,10). The use of dika fat as a tablet glidant/lubricant was first reported by Udeala et al., (10) and they showed that it improved the flow of granules and produced tablets with better disintegration times and dissolution profiles than magnesium stearate at all concentrations.

In the present investigations a study has been made of the effects produced on the ratio, ER/SR. on tablet strength and disintegration times by adding up to 10% w/w dika fat to the following powders: Sta-Rx, Emcompress and lactose and the results compared with those containing stearic acid. Sta-Rx was chosen as representative of plastic material and Emcompress and lactose as representative of brittle materials.

MATERIALS AND METHODS

The dika fat was extracted from the kernels of Irvingia gabonensia, var excelsia by the method described previously by Udeala et al; (10).

The powders were Emcompress (Albright & Wilson Ltd); Sta-Rx 1500 (Colocron Ltd); and spray dried lactose (McKesson & Robbins Ltd). Each of these powders was sieved into fractions and the size fraction with a mean diameter of 31.5um was employed in the study. For the plasto-elasti-

city testing, samples were prepared by adding up to 10% w/w of finely sifted dika fat and stearic acid BP (BDH Ltd; U.K) respectively to the powders and mixing carried out in a rotating jar with baffles for 5min.

Before testing, the samples were dried to less than 2% w/w moisture by heating and storing in a vacuum and the particle densities were determined with a Model 930 air comparison pycnometer.

Tablet preparation and Testing

Ten replicate 450mg samples of each material were formed into 10mm diameter, flat faced tablets in a Dartec M2501 Universal Tester and compressed with a load of 20kN at a rate of 0.667 kNs^{-1}. The values of Elastic Recovery (ER) and Stress Relaxation (SR) were measured from the changes in dimensions of the tablets during application and release of pressure as previously described in detail (3 - 6).

The dimensions and weights, of the tablets were accurately measured and their packing fractions calculated (4). Their tensile strengths were determined by diametral compression (11) using a CT 40 tester (Engineering System, Nottingham) and applying the same equation as in previous papers (4,5,6).

The disintegration times were measured individually on five lactose tablets from each batch in distilled water at 37 $\pm$ 1°C using the BP 1973 method and a Manesty Disintegration Tester, and an average calculated.

RESULTS AND DISCUSSION

The results illustrated in Figs. 1A and 1B show the changes produced by dika fat in the values of the ratio, ER/SR and tensile strengths. The changes produced by stearic acid followed similar trends. It may thus be reasonable to infer that dika fat possesses some lubricant properties and confirms the findings of Udeala et al., (10) who showed that dika fat is a good glidant/lubricant which compares favourably with magnesium stearate.

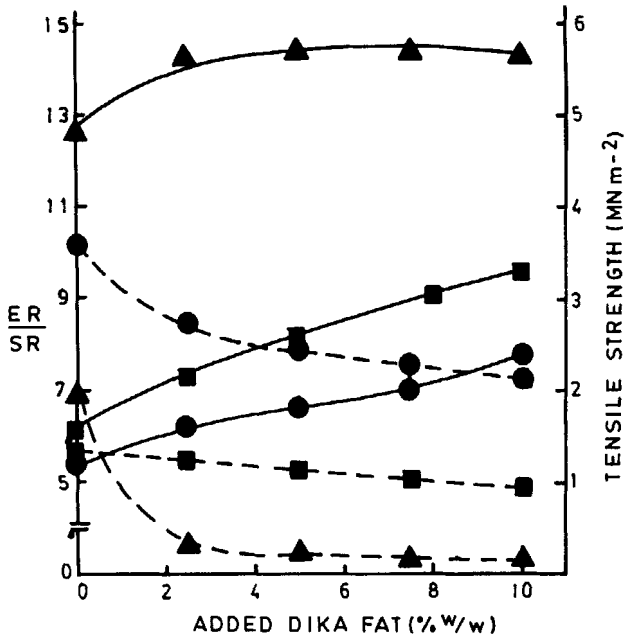

FIG.1A: ER/SR and tensile strength versus % /w of added dika fat; ——ER/SR – – – – Tensile strength ▲ Sta - Rx, ■ Lactose, ● Emcompress

In all cases, increasing the amount of the lubricants caused an increase in the elastic recovery (ER), a decrease in the stress relaxation (SR) resulting in an overall increase in the ratio, ER/SR and a decrease in tensile strengths of the resulting tablets as shown in Figs. 1A and B. This result accords well with those of previous workers (4,5) and it may well be that both dika fat and stearic acid, being lubricants, are inherently less cohesive than the other three powders. When they were added to the powders they formed a coat around the individual particles which remained more or less intact during compression. Their presence on the powders' particles would reduce the surface van der Waal's type cohesive forces on the particles; would make it easier for the particles to slide past each other during compression, decreasing the apparent

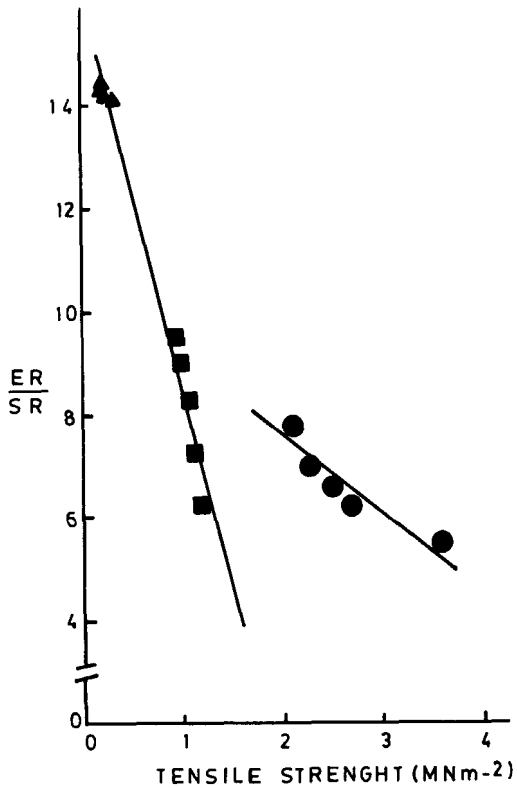

FIG.1B:ER/SR versus tensile strength at Pf = 0 91 for the powders containing up to 10% w/w dika fat.
▲ Sta-Rx, ■ Lactose
● Emcompress Pf = 0.73

TABLE 1. Mean disintegration time for lactose tablets containing varying concentrations of lubricants.

Concentrations of Lubricant	Mean disintegration time (min)	
% w/w	Dika fat	Stearic acid
0	0.56	0.56
2.5	1.26	3.50
5.0	2.00	7.62
7.5	4.23	13.40
10.0	7.31	21.10

plastic deformation of the particles and thus inhibiting the number and strength of bond formed between them (4,5).

The inverse relationship between ER/SR and tensile strength at fixed packing fraction shown in Fig. 1B is also in agreement with the results obtained by previous workers (4 - 6) for mixed, coated and heated powders.

On their effect on disintegration, it is seen, Table 1, that both materials increased the disintegration times of lactose tablets but stearic acid prolonged the disintegration times than dika fat. This is to be expected since both materials are hydrophobic in nature and have the ability to reduce water penetration into the tablets. But it may be assumed that stearic acid is more hydrophobic than dika fat or that the former forms a more efficient coat around the powder particles than the latter.

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