

CONCLUSIONS.

1. The factors largely responsible for the variation in the weight of pills made by pharmacists are (1) the nature of the excipient used, (2) the amount of care exercised in compounding, and (3) the length of time which is permitted to elapse before the pills are weighed.

The nature of the excipient used is not responsible for the variation in the weight of individual pills of the same batch, but is probably the principal cause for difference in the weight of batches of pills made by different individuals.

2. From the data obtained in the tests made it would seem that twice the average standard deviation is a reasonable margin of error for weight. This margin will cover 99 per cent of the batches of pills made in filling prescriptions Nos. 1 and 3, and 96 per cent of the batches made in filling prescription No. 2. Expressed in terms of percentage, a margin of error of 13.1 per cent variation from the average weight would cover all the above cases. From this it is concluded that a margin of 15 per cent deviation from the average weight would be reasonable and should be permitted.

(To be continued.)

A STUDY OF THE EMPTYING TIME OF THE STOMACH WITH REFERENCE TO PILLS AND TABLETS.*

BY F. S. BUKEY AND MARJORIE BREW.

The results reported in this paper have been obtained from a rather extensive study of enteric coatings. By use of the X-ray, many interesting facts were found concerning the length of time pills, tablets and capsules remain in the stomach.

Early investigators have stated that pills would remain in the stomach from one to six hours. However, the consensus of opinion was that from one to three hours was the normal emptying time. The X-ray studies indicate that six hours is about the average emptying time.

Apparently, size and shape of pills or tablets has little to do with the length of time they remain in the stomach. Pills of 7.2 mm., 5.9 mm. and 3.9 mm. in diameter, and compressed tablets of 10.5 mm. in diameter and 4.8 mm. in thickness were used. Also square tablets 10 mm. by 10 mm. and 5 mm. in thickness and rectangular tablets 12.5 mm. by 8.5 mm. by 3.5 mm. were given. The tablet and pill masses contained BaSO₄ in order that they might be observed by X-ray. In cases where the individuals were given nine pills, three of 7.2 mm. in diameter, three of 5.9 mm. in diameter and three of 3.9 mm. in diameter, it was not uncommon to find that the larger pills left the stomach first.

The subjects used in the study were normal and apparently in good health. The same individual was used repeatedly in order to determine individual variation. These individual variations made it almost impossible to state a general rule on

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emptying time. It was found that the same subject given the same kind of pills on two different days, would react differently. For example, subject L. H. was given three tablets and the X-ray pictures showed them to be out of the stomach in one hour. On another day, the same subject was given five tablets of the same size and the X-ray pictures showed three tablets to be out of the stomach in four hours and the other two remained there for a longer period of time. This variation was undoubtedly due to the condition of the individual, the type of food eaten and the concentration of gastric juices; for this reason, an emptying time constant for the individual is rather difficult to determine.

A few experiments have been conducted using specific diets and the results indicated that the diet may have an influence upon the length of time pills, tablets and capsules will remain in the stomach. Further study is being conducted on this phase of the problem.

Several types of enteric coatings were studied. Such coatings as salol-shellac, salol-balsam, keratin, stearic acid, stearic acid-carnauba wax and tolu were used in addition to the usual type of commercial enteric coatings. Tolu coatings were not studied with the idea of determining their enteric value but to find whether they would disintegrate in the alimentary tract. Very few pills or tablets with the tolu coatings disintegrated in the stomach, thus it made an excellent means of studying emptying time. On abstracting the results of these experiments, it was evident that the type of coating has little to do with the time that pills, tablets or capsules will remain in the stomach.

In this study 367 pills, tablets and capsules were given and 96 subjects were used. The following table gives the number of subjects and the number of times they were used.

TABLE I.—NUMBER OF SUBJECTS; TIMES USED.

Number Subjects.	Times Used.	Number Subjects.	Times Used.
16	1	5	4
12	2	2	5
6	3	1	8

The following table gives the emptying time in hours for tablets, pills and capsules of the indicated dimensions with no regard to the type of coating.

TABLE II.—EMPTYING TIME IN HOURS.

Type.	Size in Mm.	No. of Pills Out of the Stomach at the End of the Listed Hours.																		
		2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	15.	17.	19.	21.				
Tablets	10.5 x 4.8	15	39	37	14	12	3	3	0	4	0	0	0	0	0	0				
Capsules	18.3 x 5.9	0	3	2	3	0	1	0	0	0	0	0	0	0	0	0				
Pills	7.2	13	10	2	1	1	2	0	1	0	0	0	0	0	0	0				
Pills	5.9	5	4	5	3	0	1	0	0	0	0	0	0	0	0	0				
Pills	3.9	2	0	0	4	0	3	3	0	0	0	0	0	0	0	0				
Pills	6	0	10	20	28	6	9	0	3	8	18	5	1	12	10	1				
Tablets (sq.)	10 x 10 x 5	8	4	0	5	3	0	0	0	0	0	0	0	0	0	0				
Tablets (rect.)	12.5 x 8.5 x 3.5	15	0	5	0	0	0	0	0	0	0	0	0	0	0	0				

The following table gives the total number of pills, tablets and capsules which were out of the stomach at the end of the stated time with no respect to the shape or enteric coating.

TABLE III.—TIME OUT OF STOMACH.

Number.	Hours.	Number.	Hours.
58	2	4	9
70	3	12	10
71	4	18	11
58	5	5	15
22	6	12	17
19	7	10	19
6	8	1	21

The largest number of pills passed out of the stomach in four hours, but the average emptying time calculated from this table was found to be five and nine-tenths hours.

The following table gives the emptying time in hours for pills and tablets based upon the type of enteric coating used with no regard to size.

TABLE IV.

Type of Coating.	No. of Pills Out of the Stomach at the End of the Listed Hours.																				
	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	
Tolu (S. B. Penick.)	0	0	1	5	0	2	0	3	0	0	5	0	0	0	0	0	0	4	0	1	
Tolu (Huiscking.)	0	10	0	10	0	5	0	1	3	7	0	0	0	1	0	2	0	4	0	0	
Tolu (Eimer & Amend)	0	0	7	17	0	3	0	0	4	0	0	0	0	0	0	9	0	0	0	0	
Tolu (Hopkins)	0	0	12	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	
Keratin.	0	1	0	3	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	
Stearic acid	0	6	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Salol-Balsam	5	12	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Salol-Shellac	2	0	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Carnauba wax and stearic acid	11	4	9	3	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	

Several conclusions have been drawn from this study. *First*, that the size and shape of a pill, tablet or capsule have no effect on the length of time it will remain in the stomach. *Second*, that the same individual does not react uniformly toward this type of medication with reference to emptying time. *Third*, that indications point to the fact that the emptying time may be influenced by the type of diet. *Fourth*, that the type of enteric coating does not have any effect on the length of time that pills, tablets and capsules will remain in the stomach.

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PRESCRIPTION PROBLEMS.*

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A large number of interesting prescriptions has been collected from the files of the Illinois Research Hospital, a few of which are presented in this article. Each one presents some difficulty which can be remedied, instead of compounding as written and dispensing a disagreeable-looking prescription.

R_x 1

Lugol's Solution	20.0
Compound Elixir of Pepsin q. s.	120.0

* Section on Practical Pharmacy and Dispensing, A. Ph. A., Washington meeting, 1934.