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Research Article

Effect of Preparation Method on some Physical and Mechanical Properties of Prepared Effervescent Granules

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ABSTRACT

Granulation is a process of particle size enlargement of powdered ingredients and is carried out to confer fluidity and compressibility to powder system. Granulation of fine powders is intended to improve flow characteristics and to overcome segregation of the constituent.[1] There are two granulation methods, wet method, which utilize a liquid in the process and dry method in which no liquid is used.

The aim of this work was to study the effect of method of granulation on some physical and mechanical properties of the effervescent granules prepared by wet and dry granulation methods.

Tartaric acid, citric acid and sodium bicarbonate were used as effervescent base, vitamin C was used as an active ingredient and ethanol was used as granulating agent in case of wet granulation method. All used materials were of B. P. Grade.

Quantities of materials were calculated, accurately weighed, mixed and granulated by wet or dry method forcing the mass to pass through 1000 micrometer sieve and collected on another 710 micrometer sieve using thumb or spatula. The collected granules were then dried in a hot air oven and packed protected from moisture. Prepared formula were then evaluated regarding their bulk volume, bulk density, tapped volume, tapped density, flowability, compactibility and cohesiveness using angle of repose, Hausner ratio, Carr index, pour and tapped densities and Kawakita equation.

From the results of this work, it was noticed that the granules prepared by dry method occupied less volume with higher density having lower values of angle of repose, Hausner ratio and Carr index indicating better flowability compared with granules prepared by wet method because of the use of the granulating agent in case of wet granulation leading to larger granules with less fines.

The granules prepared by dry method had higher values of compactibility and lower values of cohesiveness because wet granulation gives hard and large granules with less fines compared to granules prepared by dry method which gives fragile and smaller granules with more fines.

The granules prepared by the use of thumb had better flowability and compactibility compared to that prepared by the use of spatula because the use of thumb is more controllable giving more spherical particles compared with the use of spatula.

Keywords: Hausner ratio, Carr index, Kawakita equation, compactibility.

INTRODUCTION

Granulation is a process of particle size enlargement of powdered ingredients and is carried out to confer fluidity and compressibility to powder system.

Granulation of fine powders is intended to improve flow characteristics and to overcome segregation of the constituent.[1] There are two granulation methods,

wet method, which utilize a liquid in the process and dry method in which no liquid is used.
The aim of this work was to study the effect of method of granulation on some physical and mechanical properties of the effervescent granules prepared by wet and dry granulation methods.

MATERIAL:
Tartaric acid, citric acid and sodium bicarbonate were used as effervescent base, vitamin C was used as an active ingredient and ethanol was used as granulating agent in case of wet granulation method. All used materials were of B. P. Grade.

METHODS:
Quantities of materials were calculated, accurately weighed, mixed and granulated by wet or dry method forcing the mass to pass through 1000 micrometer sieve and collected on another 710 micrometer sieve using thumb or spatula. The collected granules were then dried in a hot air oven and packed protected from moisture. Prepared formula are presented in table 1. Prepared formula were then evaluated regarding their bulk volume, bulk density, tapped volume, tapped density, flowability, compactibility and cohesiveness using angle of repose, Hausner ratio, Carr index, pour and tapped densities and Kawakita equation.[2,3]

Table 1: Formula of effervescent granules

Formula	Preparation method
W.H	Wet method using thumb
W.S	Wet method using spatula
D.H	dry method using thumb
D.S	dry method using spatula

BULK AND TAPPED VOLUME
20 grams of the prepared granules were introduced into a 100 ml graduated measuring cylinder and the initial volume (V_0) was recorded. The measuring cylinder was tapped twice and the volume (V_2) was recorded. This step was repeated recording the volume after each 2 taps (V_4, V_6, V_8 …etc.) until no change in the volume, which is the final volume or the tapped volume (V_f). this tapping test was repeated three times to have the average values.

BULK AND TAPPED DENSITY[4]
Densities were calculated from the recorded volumes in tapping test and the mass of used granules where:

Bulk density = Mass/initial volume

Tapped density = Mass/final volume

HAUSNER RATIO (H.R) AND CARR INDEX (C.I)
These parameters were calculated according to the following equations:

H.R =Tapped density/ Bulk density

C.I % = 100 * (Tapped density – Bulk density)/Tapped density

COMPACTIBILITY AND COHESIVENESS
These parameters were calculated using Kawakita equation as follows:
N/C = N * (1/a) + (1/ab)
Where **N** is the number of tapping, **C** is the volume reduction, **1/a** is the slope (which is related to compactibility) and **1/ab** is the intercept (which is related to cohesiveness) of the relation between **N/C** vs. **N** [5]

ANGLE OF REPOSE
This parameter was tested through formation of a static heap of the prepared granules via a funnel and measuring the angle to the horizontal.

RESULTS AND DISCUSSION
RESULTS
The results of this work is presented in table 2.

DISCUSSION
The granules prepared by wet method using spatula (W.S) have shown the largest bulk, and tapped volumes while granules prepared by dry method using thumb (D.H) have shown the smallest bulk and tapped volumes, this may be related due to that in wet granulation more granulating agent can be used compared with the dry granulation resulting in stronger granules resisting fragmentation during tapping giving larger particles with less fines.[6,7] Using thumb is more controllable than spatula therefore it gives smaller granules with narrower size range. The largest bulk, and tapped densities have shown by granules that prepared by dry method using thumb, while smallest bulk, and tapped densities have shown by granules that prepared by wet method using spatula. Also, granules prepared by wet method using spatula (W.S) have shown the largest Hausner ratio, Carr index, Angle of repose and Cohesiveness compare with all other methods but dry method using thumb (D.H) have shown the largest Compactibility. The lowest readings of Hausner ratio, Carr index and Angle of repose have shown by granules that were prepared by dry method using thumb (D.H) but lowest Compactibility and Cohesiveness readings were shown by wet method using spatula (W.S) and dry method using thumb (D.H) respectively.[7]

CONCLUSION

From our studies we can conclude that the less volume with higher density and having lower values of angle of repose were occupied for all granules that prepared by dry method. While, the better flowability of granules preparing by dry method has been indicating by Hausner ratio and Carr index incomparing with granules that prepared by wet method and this result may be due to the use of the granulating agent which lead to larger granules with less fines. Also, the higher values of compactibility and lower values of cohesiveness were indicated for granules that prepared by dry method which gives fragile and smaller granules with more fines that contrary with the wet granulation which gives hard and large granules with less fines and this lead to lower values of compactibility and higher values of cohesiveness . The specification controllable properties of thumb that give more spherical particles were produced better flowability and compactibility results for all the granules prepared by the use of thumb than that the use of spatula.

Table 2: Values of physical and mechanical parameters

	Formula			
Parameters	**W.H**	**W.S**	**D.H**	**D.S**
Bulk volume	55.67	59.00	42.66	45.17
Tapped volume	52.33	55.33	40.50	42.67
Bulk density	0.36	0.34	0.47	0.44
Tapped density	0.38	0.36	0.49	0.47
Hausner ratio	1.06	1.07	1.05	1.06
Carr index	5.99	6.21	5.08	5.53
Angle of repose	37.22	39.51	34.98	35.94
Compactibility	6.16	4.27	9.03	7.72
Cohesiveness	21.97	33.51	10.91	15.52

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