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Foam granulation v/s wet granulation: The effect of granulation technique on granule size distribution

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Abstract
The licorice root extract has been widely used in the nutriment industry as a sweetening agent as ammonium glycyrrhizin is about 50 times as sweet as cane sugar. There is a growing commercial interest in using licorice root extract in food foams. Foaming properties of licorice extract influence the sensory quality and shelf-life of the final product. So, the licorice has been tried to use as a foaming agent in place of artificial foaming agent and the results of both are compared.

Keywords: Foaming agent, licorice, foam granulation, wet granulation

Introduction
The aim of project work was to study the effect of wet granulation and foam granulation techniques on particle size distribution. Granules by wet granulation technique were prepared. Evaluation of physical parameters of granules prepared by wet granulation technique was done. Granules by foam granulation technique using tween 20, SLS and aqueous solution of liquorice as a foaming agent were also prepared. Evaluation of physical parameters of granules prepared by foam granulation technique was carried out. The results of wet granulation process and foam granulation processes were compared.

Materials and Methods
Crude Liquorice was purchased from local market, Nagpur. All other excipients and solvents used were of analytical grade.

Table 1: Formula for wet granulation

Sr. No.	Name of Ingredient	Quantity Taken
1	Paracetamol	0.5g
2	Lactose	0.5g
3	MCC	0.1g
4	Starch paste	5.0% w/w (1g in 20ml)
5	Talc	0.1% w/w
6	Magnesium stearate	0.1% w/w

Paracetamol, lactose and MCC were taken in respective quantities and triturated well in a mortar & pestle. Starch was weighed in specific amount and added slowly in beaker containing hot water kept over a Bunsen burner, while addition it is stirred well to form a paste. This paste is now added in the mixture of ingredients which were triturated before is now mixed well to form a wet mass which is then passed through a sieve having mesh no.10. In the end, talc and magnesium stearate are sprinkled over the granules and dried in an hot air oven.

Preparation of liquorice solution
The crude liquorice was size reduced to form a coarse powder. Small amount of this powder was added to about 20ml of water in a beaker and kept overnight to macerate well. It was agitated well and then filtered to get a solution of liquorice which was used as a foaming agent.

Table No. 2: Formula for foam granulation

Sr. no	Name of Ingredient	Quantity Taken
1	Paracetamol	0.5g
2	Lactose	0.5g
3	MCC	0.1g
4	Starch paste	5.0% w/w (1g in 20ml)
5	Talc	0.1% w/w
6	Magnesium stearate	0.1% w/w
7	SLS /aq.liquorice solution /tween 20	2ml

Paracetamol, lactose and MCC were taken in respective quantities and triturated well in a mortar & pestle. Starch was weighed in specific amount and added slowly in beaker containing hot water kept over a Bunsen burner, while addition it is stirred well to form a paste. This paste is now added in the mixture of ingredients which were triturated before is now mixed well to form a wet mass adding the foaming agent in appropriate quantity. This mass is now passed through a sieve having mesh no.10. In the end, talc and magnesium stearate are sprinkled over the granules and dried in an hot air oven.

Evaluation

1. Sieve analysis
2. Bulk density & tap density
3. Angle of Repose
4. Carr's Compressibility Index (CCI)
5. Hausner's Ratio (HR)

1. Sieve analysis

A weighed sample is poured into the top sieve which has the largest screen openings. Each lower sieve in the column has smaller openings than the one above. At the base is a round pan, called the receiver.

The column is typically placed in a mechanical shaker. The shaker shakes the column, usually for some fixed amount of time. After the shaking is complete the material on each sieve is weighed. The weight of the sample of each sieve is then divided by the total weight to give a percentage retained on each sieve.

5.3.2. Bulk density & tap density

Accurately weighed mucilage was poured in 100 ml graduated cylinder. The volume occupied by mucilage, before (Vb) and after tapping (Vt) were determined in triplicate using bulk density apparatus. The bulk density and tap density was calculated using the formulas.

$\rho b = M/Vb$ …… (1)

$\rho t = M/Vt$ …….. (2)

5.3.3. Angle of Repose, Carr's Compressibility Index (CCI) and Hausner's Ratio (HR)

Angle of Repose, (CCI) and (HR) were determined using following equations.

$\theta = Tan{-}1$ H/R…… (3)

Where, 'θ' is angle of repose; 'H' is height between lower tip of the funnel and the base of heap of powder; and 'R' is radius of the base of heap formed

$CCI = TD{-}BD/TD\ X\ 100$…… (4)

$HR = TD/BD$…… (5)

Where, TD and BD are tapped density and bulk density respectively.

Results and Discussion

Physical properties of granules-

The physical properties of granules were studied and observations are reported in the following table-

Table No. 3: Physical properties of granules

Sr.no	Type of granulation	Sieve analysis	Bulk density	Tapped density	Angle of repose	Hausner's ratio	Carr's index
1.	Wet Granulation.	#10 - 3.98g #22 – 0.540g #44 – 0.260g #66 – 0.160g #100 – 0.070g #120 – 0.001g	0.398	0.468	19.79 <Excellent>	1.175 <Good>	14.95% <Good>
2.	Foam granulation using tween20.	#10 – 0.860g #22 – 1.230g #44 – 0.680g #66 – 0.490g #100 – 0.260g #120 – 0.080g	0.382	0.434	28.05 <Excellent>	1.13 <Good>	11.98% <Good>
3.	Foam granulation using SLS.	#10 – 2.010g #22 – 0.980g #44 – 0.590g #66 – 0.420g #100 – 0.430g #120 – 0.060g	0.51	0.54	29.20 <Excellent>	1.058 <Excellent>	5.88% <Excellent>
4.	Foam granulation using liquorice solution.	#10 – 3.30g #22 – 0.85g #44 – 0.30g #66 – 0.10g #100 – 0.09g #120 – 0.05g	0.5012	0.5447	30.00 <Excellent>	1.0 <Excellent>	7.98% <Excellent>

Conclusion

- The sieve analysis showed highest retention in sieve no. 10 by using wet granulation and foam granulation with SLS and aqueous liquorice solution while in foam granulation with tween 20 highest retention was found on sieve no.22.

- The bulk density was obtained better in foam granulation techniques using SLS and aqueous liquorice solution.
- Tapped density also gave better results with foam granulation process by using SLS and aqueous liquorice solution.
- Angle of repose was found to be excellent by all the four techniques of granulation.
- Hausner's ratio and carr's index was found to be good in wet granulation process and foam granulation process using tween 20 while, both the parameters were found to be as excellent using foam granulation process with SLS and aqueous liquorice solution.
- The foam granulation technique when compared to the results of wet granulation process gave better results.
- The results obtained in all the physical evaluations were found to be better in foam granulation techniques.
- Foam granulation done by using SLS and liquorice solution as foaming agents gave excellent results than other types.

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