

Improving Flow and Compression Properties of Garlic and Ashwagandha Powder Using Nutracore™ Label Friendly Filler

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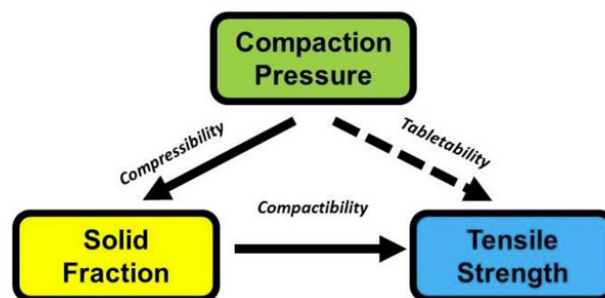
Introduction and Objectives

One of the most crucial aspects in the development of high-quality nutritional supplements is the choice of excipients – the inert ingredients that bind, stabilize, and facilitate the manufacture of these products. Among the diverse range of excipients available, Nutracore Label Friendly filler (Nutracore™) provides an all in one pioneering solution, that contains only label friendly ingredients and is specifically tailored for addressing the unique challenges posed by poorly flowing and poorly compressing nutritional ingredients. In this comprehensive exploration, we assessed the flow and compressibility of 1:1 blends of Nutracore excipient using two model nutritional ingredients (Ashwagandha powder and Garlic powder). Both Ashwagandha and garlic powder present inherent issues of poor flowability and compressibility. Remarkably, by simply blending these ingredients in a 1:1 ratio with Nutracore™, we observed a significant enhancement in flow, tableability, compressibility, and compatibility with the formulations.

Methods

The blends for direct compression were prepared by mixing the ingredients in a Turbula® blender for 10 minutes. To assess the flow properties of the formulation blends, flow analyses were conducted using a GranuDrum™ instrument. Subsequently, these blends were compressed using 6 mm flat-faced dies at compaction forces ranging from 350 kg to 950 kg force, utilizing a Gamlen™ press. Compressibility, compatibility and tableability graphs were plotted based on Figure 1, using tensile strength, solid fraction and compaction pressure data. The compaction triangle illustrates the relationships between tableting parameters.

Figure 1. Compaction Terminology¹



Results

The cohesion index and flow angle, measured at both sequence velocity and reverse velocity for Garlic, Ashwagandha powder, and their 1:1 blends, are depicted in Figure 2. It is evident that both Garlic and Ashwagandha powder exhibited poor flow characteristics, as indicated by their orange colour coding. However, when these powders were blended in a 1:1 ratio with Nutracore™, a notable reduction in the cohesion index and a substantial improvement in flow were observed, as denoted by the green colour coding.

Image A. Cohesion index and flow angle of Garlic powder

Sample Name	Mode	Info
Garlic_Pure	Speeds Hysteresis	Thixo 115.6° 46.6

Speed [rpm]	Sequence velocity		Reverse velocity		Hysteresis	
	Angle [°]	Cohesion	Angle [°]	Cohesion	Angle [°]	Cohesion
2	50.4	32.4	49.2	30.7	1.2	1.7
4	48.5	32.2	50.2	35.7	1.7	3.5
6	51.0	34.9	47.9	35.4	3.1	0.5
8	53.6	38.4	49.3	35.8	4.3	2.6
10	55.1	33.4	55.1	31.3	0.0	2.1
20	61.9	39.7	53.6	35.1	8.3	4.5
30	58.2	35.4	54.2	37.5	4.0	2.1

Image B. Cohesion index and flow angle of 1:1 blend of Nutracore™ and garlic powder

Sample Name		Mode		Info		
Colorcon Garlic Formulation		Speeds Hysteresis		Thixo 67.2° -14.3		
Speed [rpm]	Sequence velocity		Reverse velocity		Hysteresis	
	Angle [°]	Cohesion	Angle [°]	Cohesion	Angle [°]	Cohesion
2	44.8	15.2	43.1	17.3	1.7	2.2
4	43.3	16.2	43.3	18.1	0.0	1.9
6	46.7	17.8	46.4	20.9	0.3	3.0
8	44.7	22.3	44.5	19.4	0.2	2.9
10	46.3	21.2	46.0	19.0	0.3	2.2
20	48.7	23.1	43.1	24.1	5.6	1.0
30	43.1	21.8	41.7	24.0	1.3	2.2

Image C. Cohesion index and flow angle of Ashwagandha powder

Sample Name		Mode		Info		
Ashwagandha Pure		Speeds Hysteresis		Thixo 2.5° 9.3		
Speed [rpm]	Sequence velocity		Reverse velocity		Hysteresis	
	Angle [°]	Cohesion	Angle [°]	Cohesion	Angle [°]	Cohesion
2	46.0	29.9	46.9	30.1	0.9	0.2
4	43.3	27.5	47.5	28.1	4.3	0.6
6	47.3	32.3	46.9	33.1	0.4	0.8
8	44.1	30.5	47.6	30.7	3.5	0.2
10	47.7	30.9	44.4	27.4	3.3	3.4
20	46.6	32.5	45.7	27.4	1.0	5.0
30	43.1	29.3	45.4	41.0	2.3	11.7

Image D. Cohesion index and flow angle of 1:1 blend of Nutracore™ and Ashwagandha powder

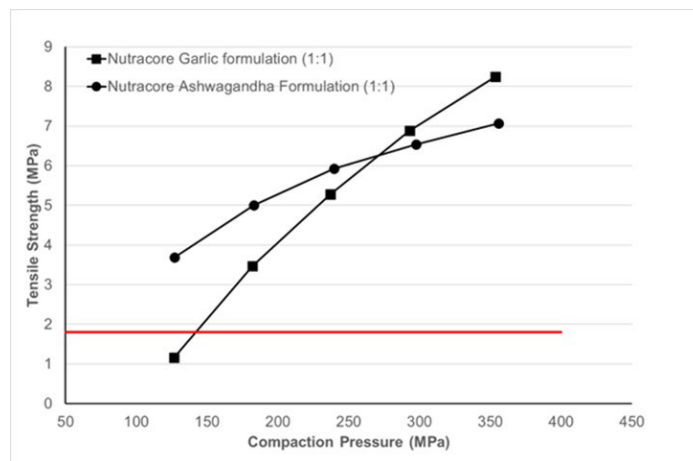
Sample Name		Mode		Info		
Ashwagandha Formulation		Speeds Hysteresis		Thixo -5.1° 19.6		
Speed [rpm]	Sequence velocity		Reverse velocity		Hysteresis	
	Angle [°]	Cohesion	Angle [°]	Cohesion	Angle [°]	Cohesion
2	41.8	13.0	41.3	17.0	0.5	4.0
4	42.1	16.4	40.1	16.0	2.0	0.3
6	41.8	21.1	42.8	20.1	1.0	0.9
8	42.6	18.8	38.7	19.6	3.8	0.8
10	39.2	25.6	42.4	20.8	3.2	4.8
20	38.6	24.3	39.8	25.9	1.2	1.6
30	39.5	30.0	36.3	28.1	3.3	2.0

Figure 2. Cohesion and flow angle of measure at various speeds: A - Garlic Powder, B – 1:1 Blend of Nutracore™ and garlic powder, C – Ashwagandha Powder and D - 1:1 Blend of Nutracore™ and Ashwagandha powder.



Figure 3 shows the Tableability profile of a 1:1 blend of Nutracore: Ashwagandha and Nutracore: Garlic powder, which is the correlation between the tablet's mechanical strength with increases in compaction pressure. The data demonstrates that the Nutracore formulation of Garlic and Ashwagandha powder gives high tensile strength >1.8 MPa at nearly all compaction pressures, which is minimum requirement for robust tablet formulation.

Figure 3. Tableability profile of 1:1 Nutracore™ with Garlic or Ashwagandha powder.



Likewise, Figure 4 presents the compatibility plot, which illustrates the relationship between a tablet's mechanical strength and solid fraction. The solid fraction represents the ratio of the tablet density in relation to the true density of the powder. The data shows both blends have a solid fraction of ≤0.90 at a nominal compression pressure of 250 MPa, indicating minimal risk of over compression.

Figure 4. Compactability profile of 1:1 Nutracore™ with Garlic or Ashwagandha powder

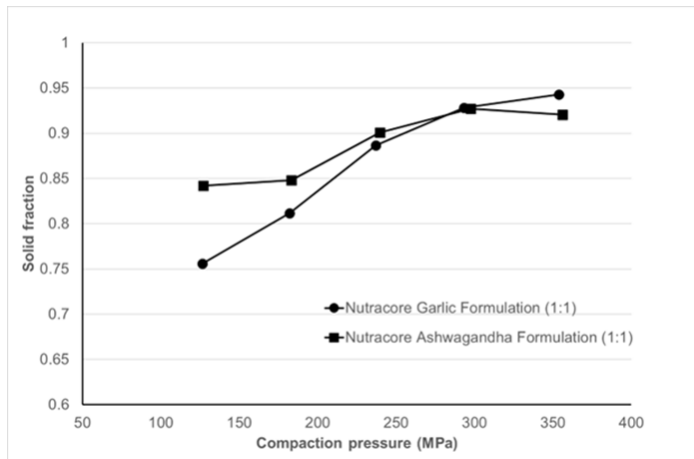
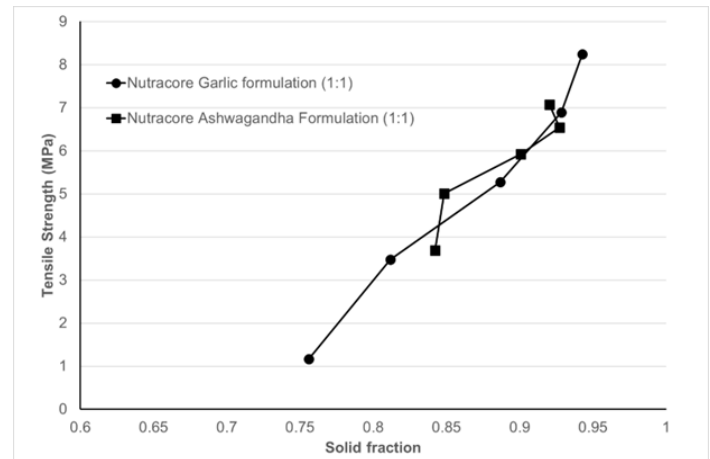


Figure 5. Compactability profile of 1:1 Nutracore™ with Garlic or Ashwagandha powder



Compressibility assesses a tablet's solid fraction, which ranges from 0 (indicating a theoretically fully porous tablet) to 1 (representing a completely solid tablet without any air pockets). This measurement is taken against various compaction pressures, typically measured in MPa. Figure 5 shows this relationship using Garlic and Ashwagandha powder blends. Both blends exhibit a high level of compressibility, resulting in the attainment of a robust tensile strength exceeding 1.8 MPa.

Conclusions and Discussion

Nutraceutical™ Label Friendly Filler, is a directly compressible excipient with demonstrated exceptional powder flow and tablet compression characteristics. These trials have strongly suggested that Nutracore™ can streamline tablet formulations and contribute to robust tablet manufacture during both formulation development and commercial tablet manufacture.

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