

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

Colorcon, Inc. Harleysville, PA 19438, USA

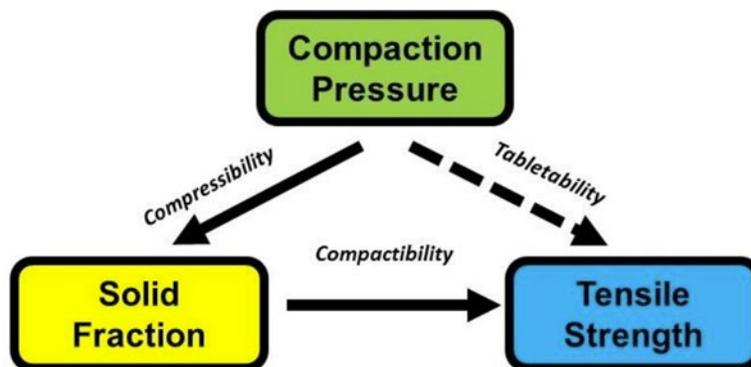
Introduction and Objectives

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 graphs¹ 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

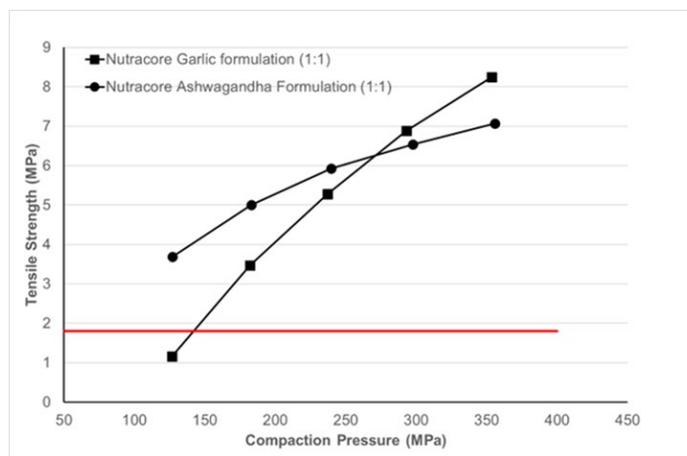
Sample Name		Mode		Info		
Ashwagandha Formulation		Speeds Hysteresis		Thixo -5.1° 19.6		
Speed [rpm]	Sequence velocity		Reverse velocity		Hysteresis	
	Angle [°]	Cohesion	Angle [°]	Cohesion	Angle [°]	Cohesion
2	41.8	13.0	41.3	17.0	0.5	4.0
4	42.1	16.4	40.1	16.0	2.0	0.3
6	41.8	21.1	42.8	20.1	1.0	0.9
8	42.6	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.



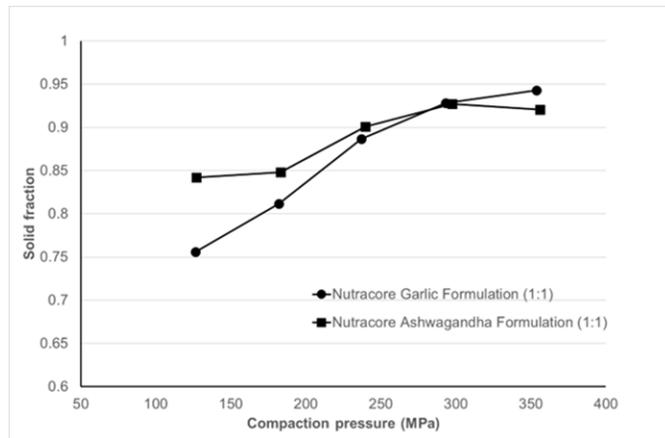
Figure 3 shows the Tableability profile of a 1:1 blend of Nutracore: Ashwagandha and Nutracore : Garlic powder, which is the correlation between the tablet’s mechanical strength with increases in compression pressure. The data demonstrates that the Nutracore formulation of Garlic and Ashwagandha powder 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.



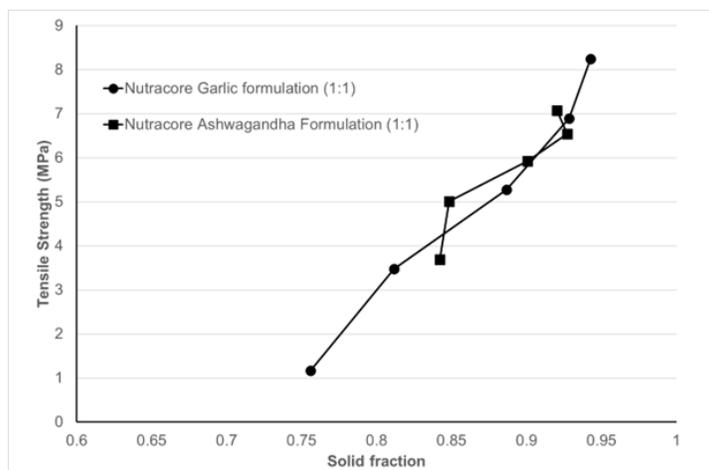
Likewise, Figure 4 presents the compatibility plot, which illustrates the relationship between a tablet's mechanical strength and solid fraction. The solid fraction represents the ratio of the tablet density in relation to the true density of the powder. The data shows both blends have a solid fraction 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



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.

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



Conclusions and Discussion

Nutracore™ 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.

Colorcon is a global company located in North America, Europe, Middle East, Africa, Latin America, India, and China.

For more information website at www.colorcon.com

The information contained herein, to the best of Colorcon, Inc.'s knowledge is true and accurate. Any recommendations or suggestions of Colorcon, Inc. with regard to the products provided by Colorcon, Inc. are made without warranty, either implied or expressed, because of the variations in methods, conditions and equipment which may be used in commercially processing the products, and no such warranties are made for the suitability of the products for any applications that you may have disclosed. Colorcon, Inc. shall not be liable for loss of profit or for incidental, special or consequential loss or damages.

Colorcon, Inc. makes no warranty, either expressed or implied, that the use of the products provided by Colorcon, Inc., will not infringe any trademark, trade name, copyright, patent or other rights held by any third person or entity when used in the customer's application.



© BPSI Holdings LLC, 2023.

The information contained in this document is proprietary to Colorcon and may not be used or disseminated inappropriately.

All trademarks, except where noted, are property of BPSI Holdings, LLC.

Nutracore™_v1_12_23