GuarNT® Bland, a Reduced Odor Stabilizer and Soluble Dietary Fiber

Florian M. Ward*

TIC GUMS, INC. 4609 Richlynn Drive, Belcamp, Maryland 21017, USA

SUMMARY: The odor and flavor of guar gum may emanate from the breakdown of lipid, protein and/or isoflavones. Guar gum is a galactomannan isolated from the annual plant, *Cyamopsis tetragonolobus,* Guar is widely used as a thickening agent but due to its characteristic off-flavor and odor, its usage level has been limited. GuarNT bland, subjected to a proprietary process to reduce its off-flavor and odor, offers the food formulator more options. GuarNT bland can be subjected to a prehydration process to improve its dispersion and increase hydration rate and avoid lumping problems during large-scale production. It is used as a thickening agent, suspending agent and a "natural" source of soluble dietary fiber (80% minimum, dry basis). Rheological data using a programmable Brookfield rheometer, hexanal levels (index of grassy flavor), PCA analyses (Aroma Scan, Foss NA) and sensory tests by trained panelists were obtained. Prototype formulations using GuarNT Bland are available and usage levels permitted by CFR are included.

Introduction

The food industry is constantly searching for a low-cost functional ingredient and fiber source with no off-flavor and odor that may affect the acceptability of the finished product. Guar gum is a plant polysaccharide, a galactomannan isolated from the seeds of an annual plant, botanically known as *Cyamopsis tetragonolobus.* The shrub requires a 20-25 week growing cycle. Some guar is grown commercially in Texas, Oklahoma, Arizona and California and is widely grown in some regions of Pakistan and India. The dicotyledonous guar seed contains 14-17% hull, 35-40% endosperm and 42-47% germ. The hydrocolloid is mainly obtained from the endosperm.

Guar gum has a mannan backbone [1], with a mannose to galactose ratio close to 2:1 (Fig. 1). The molecular weight of guar gum was reported earlier to be approximately 250,000. More recent work using gel permeation chromatography indicates that guar gum may have a molecular weight of more than one million [2]. Guar gum is widely used as a thickening and stabilizing agent but due to its characteristic off-flavor and grassy odor, its usage level has

© WILEY-VCH Verlag GmbH, D-69469 Weinheim, 1999 CCC 1022-1360/99/$ 17.50+.50/0

been limited in certain food products. This odor and flavor may arise from the breakdown of residual lipids, proteins, as well as isoflavonoid compounds.

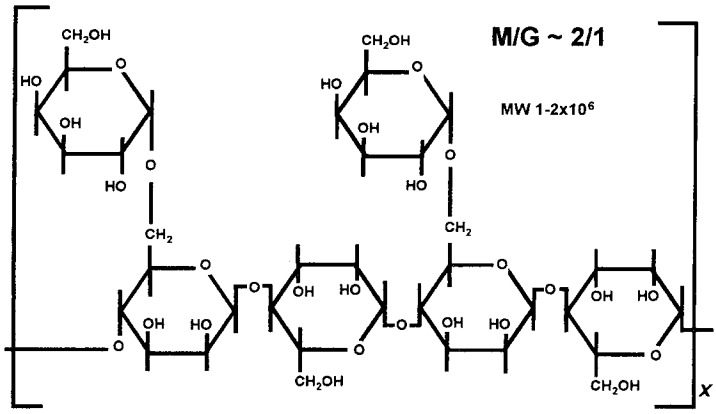

Figure 1. Structure of guar gum, a galactomannan.

A special proprietary process was developed to inhibit enzyme-catalyzed breakdown and retard formation of degradation products that may contribute to undesirable flavor and odor. The resulting product, known commercially as GuarNT Bland has the following benefits: It has reduced odor and off-flavor or mealy taste. It is relatively a low-cost thickener and contains at least 80 % soluble dietary fiber. It can bind water and prevent weeping or syneresis. Due to its non-ionic nature it is salt-tolerant and a very effective suspending agent. Guar, like locust bean gum is a galactomannan. The specifications of guar in the Food Chemicals Codex 1996 [3] are shown in Table 1. The galactomannan content should not be less than 70% and the protein content has a maximum limit of 10%.

Rheology of Guar

At pH below 3 or greater than 10, guar, as LBG, tends to degrade and lose viscosity when subjected to heating (Fig. 2). It has a zero yield value; it flows as soon as slightest shear is applied. As the rate of shear is increased, the apparent viscosity decreases sharply. Very high rates of shear can degrade the molecular structure irreversibly. A one per cent solution (1%) Guar NT Bland solution in water shows shear-thinning properties as shown in this graph obtained by varying shear rate using a programmable Brookfield viscosimeter at 26°C (Fig.3).

Table 1. Guar specifications[3].

COMPONENT	PROXIMATE ANALYSES
Galactomannans	Min. of 70 %
Acid-Insoluble Matter	Max. of 7 %
Arsenic (as As)	Max. of 3 ppm (0.0003 %)
Ash (total)	Max. of 1.5 %
Heavy Metals (as Pb)	Max. of 20 ppm (0.002 %)
Lead	Max. of 5 ppm
Protein	Max. of 10 %
Loss on Drying	Max. of 15 %
Starch	Passes Iodine Color Test

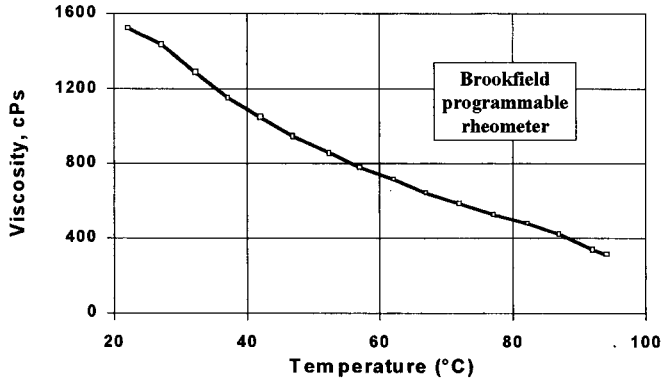

Figure 2. Effect of temperature on viscosity of GuarNT Bland.

When heated, guar thins reversibly and is non-Newtonian or pseudoplastic (Fig. 4). The effect of guar levels on the viscosity of Guar Bland is shown in this logarithmic scale (Fig. 5). Guar Bland and Guar Bland-97 were subjected to slightly different processing conditions.

A slightly lower viscosity was observed in the Guar NT-Bland. The guar levels vs. viscosity in centipoise (cP) indicate that up to 0.6% the viscosity of the GuarNT BLAND is lower than 500 cP. (Table 2). It is slightly lower in viscosity than regular guar but retains its good suspending properties. The change in viscosity with time as an index of hydration is shown in

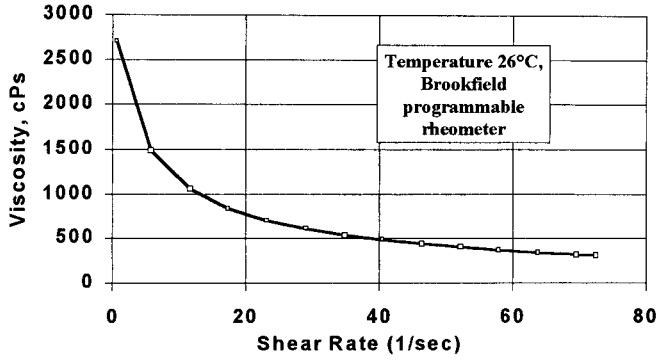

Figure 3. 1% GuarNT Bland, shear rate vs. viscosity showing shear thinning property.

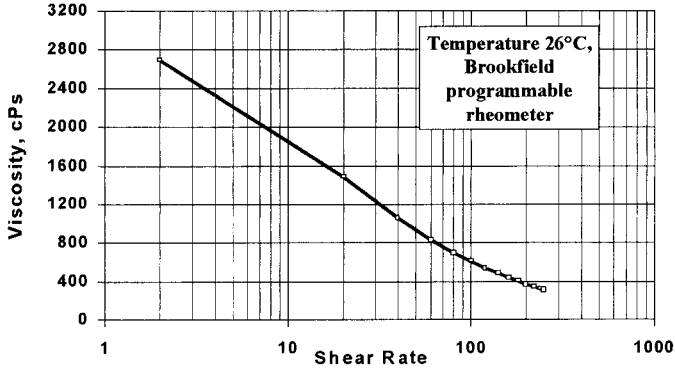

Figure 4. Shear rate vs. viscosity of GuarNT Bland.

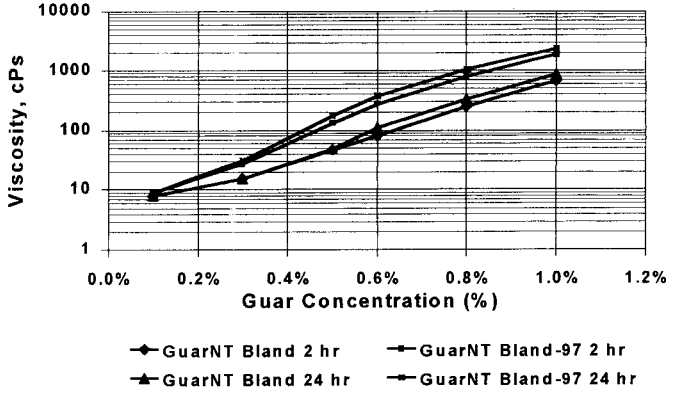

Figure 5. GuarNT Bland levels vs. viscosity (log plot).

Table 2. Effect of guar levels on viscosity.

Concentration →	0.1%	0.3%	0.5%	0.6%	0.8%	1.0%
GuarNT Bland (2 hr)	8	16	47	82	251	676
GuarNT Bland-97 (2 hr)	9	28	130	273	802	1870
GuarNT Bland (24 hr)	8	16	49	112	334	864
GuarNT Bland-97 (24 hr)	9	31	177	373	1062	2390

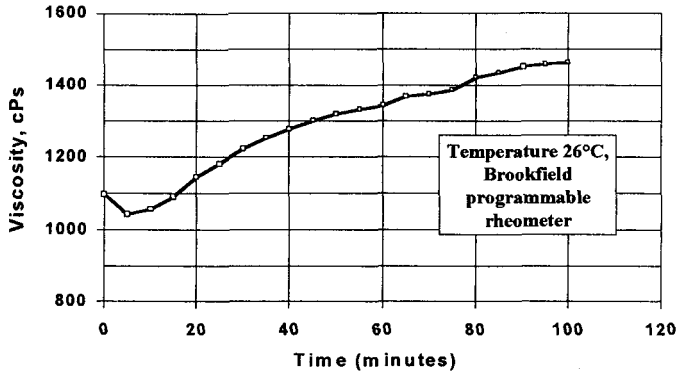

Figure 6. Change in viscosity with time for GuarNT Bland solution.

Fig. 6. As the temperature increases, the viscosity of the guar solutions decreases. The initial viscosity is regained after the original temperature is reached.

Odor Profile Assessment

The principal component analyses of guar gums subjected to various manufacturing procedures to reduce odor has shown that the AromaScan (Foss North America) can detect differences between the various specialty types of guar. The AromaScan device [4)] is an "electronic nose" that is based on the use of polymers that absorb volatile components. The PCA (principal component analysis) map allows for sample to sample comparisons by

reducing 32 parameters of data (generated by the 32 sensors in the system) to a point in a 2 or 3-D map. Clustering of replicates was readily observed (Fig. 7).

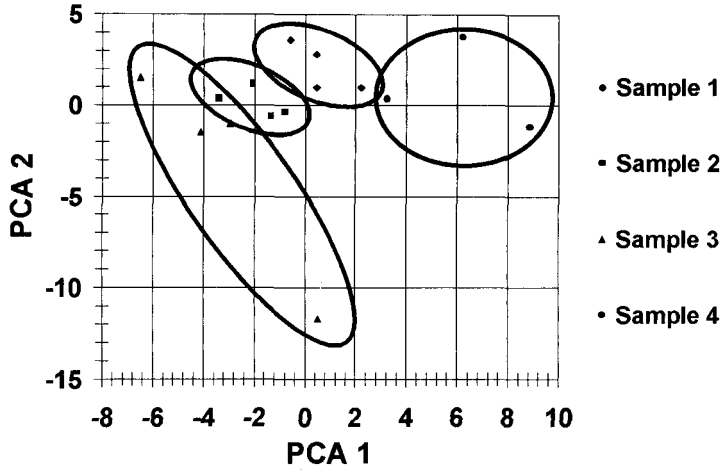

Figure 7. PCA: AromaScan of GuarNT Bland (Data from Foss North America, 9/97).

In Figure 7, samples 1, 2, and 4 were prepared using various procedures employed to reduce off-odor and off-flavor in guar. Sample 3 represents the control or untreated guar.

The hexanal level (as an index of the grassy odor) of GuarNT bland was analyzed by gas chromatography. A 75 - 90 % reduction in original hexanal levels (3,200 ppb) in untreated samples vs. deodorized material (100-800 ppb) was achieved. In sensory tests conducted using coded samples, nine out of ten panelists preferred GuarNT Bland to the regular guar gum as to odor and flavor.

Food Applications of Guar NT Bland

The various applications of guar gum in food products are so extensive that it can be found in the ingredient labeling of a wide variety of foods. GuarNT Bland since its label declaration is guar gum is subject to maximum usage levels as specified in the Code of Federal Regulations (Title 2 1). Table 3 shows the maximum usage levels of guar [5)] in jams and jellies, milk products, soups and soup mixes, vegetable juices, sauces, toppings and syrups. Maximum usage levels for guar gum in various products: baked goods and bake mixes, breakfast cereal,

cheese, dairy products and analogs, fats and oils and gravies and sauces are also shown in Table 3.

Table 3. Maximum usage levels for guar (21 CFR 184.1339).

Food (as served)	Function	Max. %
Jams & jellies	Same	1.0
Milk products	Same	1.0
Processed vegetables & vegetable juices	Formulation aid, Stabilizer & thickener	2.0
Soups & soup mixes	Same	0.8
Sweet sauces, toppings, & syrups	Same	1.0
All other food categories	All of the above	0.5

Food (as served)	Function	Max.%
Baked goods & baking mixes	Emulsifier, Stabilizer & thickener	0.35
Breakfast cereal	Formulation aid, Stabilizer & thickener	1.2
Cheese	Same	0.8
Dairy products & analogs	Firming agent, Formulation aid, Stabilizer & thickener	1.0
Fats & oils	Same	2.0
Gravies & sauces	Formulation aid, Stabilizer & thickener	1.2

Specific examples of dairy applications of guar include use in ice cream, ice milk, cottage cheese, cheese dips etc. In beverages, GuarNT bland can be used due to its reduced flavor in delicate-flavored juices and syrups. Guar is also used as part of a fat mimetic system in various food products [6].

Using a centrifugation method developed, the water-binding capacity of various specialty products of guar can be determined semi-quantitatively. Under the conditions of the test, GuarNT Bland can bind 22 times its weight of water.

Advantages and benefits derived from GuarNT Bland

Guar gum is relatively a low-cost thickener, fiber source, suspending agent, emulsion stabilizer and multi-functional food and pharmaceutical ingredient. In formulating foods and nutraceuticals with Guar NT Bland, it is important to note the multiple health benefits derived from this "natural" product. It acts as a soluble dietary fiber [7] and guar has been reported to lower serum low density lipoprotein (LDL) cholesterol as well as improve glucose tolerance [8] in diabetics. It can also influence fecal volume and gastrointestinal function.

Prehydrated, Reduced Odor Guar

GuarNT Bland may also be made available in prehydrated form, to achieve a dust-free environment and for faster hydration, if desired. Prehydration is a term coined to describe the process of agglomeration of hydrocolloids, in which water is added and turbulent air is applied to dry the material. The process creates interstitial voids that facilitate the imbibition of water into the powdered material. It produces larger particle size distribution and a lower bulk density.

Conclusions and Recommendations

GuarNT Bland is highly recommended and preferred due to its low cost and functionality as well as its multiple health benefits, natural labeling and particularly due to improved sensory characteristics (flavor and odor). Its use will widen the opportunities for the food designer in formulating new products with delicate flavor and health benefits at a reduced cost.

Acknowledgments

The author would like to thank Stephen Andon, Chris Andon, Dr. Mar Nieto, Steve Hartley, Jim Caulfield, and Stuart Cantor of TIC Gums, Inc. for their contributions related to the commercialization of the product. The author appreciates the technical help of Marcy Russell of Foss North America for the AromaScan analyses and Dr. Richard Ward of RBW Consulting, for assistance in preparing the graphics and manuscript for publication.

References

1) M.Glicksman, *Food Hydrocolloids* **3**, 158 (1982), CRC Press,Inc. Boca Raton, Florida.
2) R. L. Whistler and J. N. BeMiller, *Industrial Gums*, 3rd Ed. Academic Press, San Diego, CA, 1993.
3) *Food Chemicals Codex,* National Academy Press, Washington DC, 1996.
4) C. Fisher and T. R. Scott, *Food Flavours, Biology and Chemistry,* Royal Society of Chemistry Information Services, 1997.
5) CFR21 170–179, Federal Register Office, National Archives and Records Administration, Washington DC, 1997.
6) F. M. Ward, *Cereal Foods World* 1997, 42(5) 386.
7) M. L. Dreher, *Handbook of Dietary Fiber,* Marcel Dekker, Inc. New York NY, 1987.
8) P. R. Ellis and E. C. Apling, *Br. J. Nutr.* **45,** 267, 1981.