



Role of guar in agro-industries

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Abstract

Agricultural sustainability has the highest priority in all countries, whether developed or developing. Guar-native to the Indian subcontinent is a drought tolerant, multi-purpose legume crop cultivated mainly in the kharif season in arid environments. Guar gum is an edible thickening agent extracted from the guar bean. Guar beans have a large endosperm which contains galactomannan gum which forms gel in water. It mainly consists of hydrocolloidal polysaccharide with a high molecular weight, which consists of galactopyranose- and mannopyranose- units in glycosidic linkage which can be chemically described as galactomannan. The guar seed comprises three parts: the seed coat (14-17%), the endosperm (35-42%), and the germ (43-47%). In India the commercial production of Guar gum is normally undertaken by using process of roasting, differential attrition, sieving and polishing. Guar plays an important role in many industries like oil well drilling, textile printing, paper, explosive, mining, frozen food, bakery, dairy products, beverages, pet foods, slimming aids, diabetic treatment, tablet preparation, ointment, soaping and shampoo, etc. as it is one of the best thickening additives, emulsifying additives and stabilizing additives and thus an important foreign exchange earner for the country.

Keywords: Agro-industries, Guar gum, legume crop

Introduction

Guar or cluster bean [*Cyamopsis tetragonoloba* (L.) Taub], a native to the Indian subcontinent is a drought tolerant, multi-purpose legume crop cultivated mainly in the *kharif* season in arid environments. It is commonly known as guar, chavli, kayi, guari, khutti. Guar is grown mainly in India, Pakistan, United States and also in some part of Africa and Australia. In India, the crop is mainly grown in the dry habitats of Rajasthan, Haryana, Gujarat and Punjab and to a limited extent in Uttar Pradesh and Madhya Pradesh. Rajasthan alone comprises almost 78 per cent area and 81 per cent production to the national basket of Guar (Anonymous, 2011) [1]. India is the largest producer and exporter of guar in the world accounting for about 80% of total production. The germ has toxic effect but recently advanced research has been made on the germ to reduce its toxic effect and to make it suitable for animal consumption as a rich source of the protein (Murwan and Abdalla, 2008) [7]. Guar seeds are a rich source of mucilage or gum, a natural hydrocolloid, which forms a viscous gel in cold water and used as an emulsifier, thickener, stabilizer in a wide range of food and industrial application (Marina *et al.*, 2007) [6]. Guar galactomannan has mannose to galactose (M: G) ratio of 6:1 (Edwards *et al.*, 1992) [2]. The pure mannanose without galactose is completely insoluble in the water, but increasing of galactose substitution in guar gum increase the solubility of the polymer by allowing it to become attended (Noble *et al.*, 1989) [8]. The mannose to galactose ratio is 2:1, guar gum is insoluble in organic solvent, molecular weight range is 50.000 – 80.000 and gum is a white to yellowish white, nearly odorless, free flowing powder with a bland taste (Yoko, 2008) [12].

Nutritional Information

Table 1

Nutrition Content	Amount per 100 g
Energy	16Kcal
Moisture	81g
Protein	3.2g
Fat	1.4g
Carbohydrate	10.8g
Vitamin A	65.3IU
Vitamin C	49 mg
Calcium	57 mg
Iron	4.5 mg

** (Kumar and Singh, 2002)

It is one of the most important and potential vegetable cum industrial crop grown for its tender pods for vegetable purpose and endospermic gum [30-35%]. The guar seed comprises three parts: the seed coat (14-17%), the endosperm (35-42%), and the germ (43-47%). It is from the endosperm that guar gum is derived, which is the prime marketable product of the plant. This spherical-shaped endosperm contains significant amounts of galactomannan gum (19-43% of the whole seed), which forms a viscous gel in cold water. Like other legumes, guar is an excellent crop for enhancing soil fertility. Its root nodules contain nitrogen-fixing bacteria and crop residues, when ploughed under soil, improve yields of the succeeding crops. The by-products of guar processing, 'Churi' and 'Korma' are used as cattle feed. Guar gum recovery normally constitutes around 31 per cent of the total

guar seed processed, whereas *Churi* and *Korma* account for 29 per cent and 37 per cent, respectively (Sharma and Gummagolmath, 2012) [9].

As guar is a drought resistant crop and therefore, it can be grown successfully in areas where average rainfall is 30-40 centimeter. It is a crop preferring warm climate and grows well in the subtropics during summer. Proper germination of seeds and root development takes place between 25 and 30°C temperatures. It cannot stand water logging conditions at all. It is a photosynthetic crop, it comes into flowering and fruiting when sown in *kharif* season only (Singh *et al.* 2008). Some of the Varieties of guar for different regions are Pusa Navbahar, Pusa Mausami, Pusa Sadabahar, GH-10, HFG-119, Ageta Guara-111, Guar No.2, FS-277, Durgapur Safed, etc. for Northern India and Pusa Navbahar, Pusa Sadabahar, GH-10, HFG-119, Saradbahar, IC 11704, P-28-1, CP-78, S-299-7, IC-11521, etc. for Southern India (Ganesh Prajapat, 2012 and Vinod Kumar, 2013) [3, 11]. Guar gum has multiple industrial use such as oil well drilling, textile printing, paper, explosive, mining, frozen food, bakery, dairy products, beverages, pet foods, slimming aids, diabetic treatment, tablet preparation, ointment, soaping and shampoo, etc. and thus an important foreign exchange earner for the country (Kumar, 2005) [11].

Manufacturing Process of Guar Gum:

is about 25% in husks.

In India, depending upon the requirement of end product various processing techniques is used. Guar gum production is normally undertaken commercially by using process of roasting, differential attrition, sieving and polishing. The stage wise process for manufacturing food grade guar gum is as follows- Guar splits are selected. The splits are screened to clean and then soaked to prehydrate in a double cone mixer. Pre hydrating stage is very important as it derives the rate of hydration of the final product. The soaked splits, with high moisture content, are passed through Flacker to take them. The flaked guar splits are ground to desired particle size followed by drying. Through rotary screens the powder is screened to deliver required particle size. As per viscosity requirement, the oversize particles are either recycled to main ultra-fine or regrind in separate regrind plant. This stage helps to reduce the load at the grinder. The soaked splits are difficult to grind. As direct grinding of those generates more heat in the grinder which is not desired as it results in insoluble or reduced hydration of the product in the process. Through heating, grinding & polishing process the husk is separated from the endosperm halves and the refined Guar Gum split are obtained. Through grinding process the refined Guar split are then treated and converted into powder. During the split manufacturing process, husk & germ are obtained which are used as a cattle feed as they are rich in protein. It is widely sold in the international market as “Guar Meal” and has contents of “Oil & Albuminoids”. These contents are about 50% in germ whereas it



A) Whole plant of guar



B) Matured seeds of guar

Application of Guar Gum in Industry

A) Food Industry

Guar gum is one of the best **thickening emulsifying** and **stabilizing additives**. In Food Industry, it is used as gelling, viscosifying, thickening, clouding, and binding agent as well as used for stabilization, emulsification, preservation, water retention, enhancement of water soluble fiber content etc. Some

food products in which guar gum powder is used are- ice cream, soft drinks & concentrates, puddings, chocolate milk, flavoured milks, jams, jellies, fruit spreads, jelly sweets, bread, biscuit and other baked foods, ham and sausages, soft cheese and cheese spreads, canned or retorted food of fish and meat, myonnaise, ketchup, sauce and dressings, noodles and pasta.

B) Pharmaceutical Industries

In pharmaceutical industries, it is used as In tablet manufacturing it is used as a binder and disintegrating gelling, viscosifying, thickening, suspension, stabilization, emulsification, preservation, water retention or water phase control, binding, clouding/bodying, process aid, pour control for following applications, agent and in micro-encapsulation of drugs.

Guar Gum is an important non-caloric source of soluble dietary fiber. Guar gum powder is widely used in capsules as dietary fiber. Fiber is a very important element of any healthy diet. Its synergistic mix of guar gum and fiber mixture when taken with water expands in stomach to produce a feeling of fullness.

C) Cosmetic Industries

It used as a thickener, protective colloid in Skin care products, creams and lotions. Also used in toothpaste, and shaving cream for easy extruding from the container tube.

D) Industrial Use

In Industrial Applications, guar gum powder is a very versatile product and finds its different applications, as thickening, sizing agent, wet-end strength additive, gelling agent and water barrier, flocculation aid, for waste water treatment, as emulsifier, binder. Also used for mud formulations, enhanced oil recovery, polymer flooding, well treatment, lost circulation plugging etc. Mining grade guar gum is used in mining industry as a floatation agent flocculating or setting better quality agent. Fast hydration guar gum powder for oil drilling applications is an important advantage of guar gum. Ultrafine Gums in India supply oil drilling grade guar gum, guar gum for paper industry, guar gum as an emulsifying, guaran and sickle pod.

Guar Gum Industrial grade powder is used in some industries as follows

Textile Printing & Sizing, Fire Fighting, Ceramics, Pharmaceuticals, Printing Inks, Mosquito Mats, Synthetic Resins, Paper Industry, Battery Electrolytes, Water Treatment, Floatation Agent, Water Paint, Carpet Printing, Oil Well Drilling, Explosives, Mining etc.

Paper Industry

Guar Gum provides better properties compared to substitutes. It gives denser surface to the paper used for printing and imparts improved erasive and writing properties, better bonding strength and increased hardness. It also gives better breaking, mullen and folding strengths due to improved adhesion.

Textile Industry

Guar Gum gives excellent film forming and thickening properties when used for textile sizing, finishing and printing. It helps reducing warp breakage, reduces dusting while sizing and gives better efficiency in production.

Oil Field Applications

Industrial grade Guar gum powder are use in oil well fracturing, oil well stimulation, mud drilling and industrial applications and preparations as a stabilizer, thickener and suspending agent. High viscosity Guar Gum products are used as drilling aids in oil well drilling, geological drilling and water drilling. Guar gum is used as a surfactant, synthetic polymer and deformer ideally suited for

all rheological requirements of water-based and brine-based drilling fluids. These products also reduces friction in the holes, and so minimising power requirements

Metallurgical and Mining

Guar gum is widely used as a flocculants to produce liquid solid separation. It is also used in flotation which acts as a depressant for talc or insoluble gangue mined along with the valuable minerals

Explosives Applications

Gelling agents for gel sausage type explosives and pumpable slurry explosives. Cross linking agents for gel and slurry explosives systems.

Constraints for Guar Gum Cultivation:

- Rain fed crop – uncertain yield & production
- Intra and inter seasonal price fluctuations.
- Delicate balance of Guar supply chain affected by heavy rain by moisture damage & mold, late harvest, fungus & blackening.
- The domestic growers have problem in convincing the buyers i.e. manufacturers and exporters for current price situation.
- Speculative forces also drive the market, which makes it difficult to predict the commodity price trend.
- Lack of price discovery & risk management for the growers, manufacturers & shippers
- Guar gum manufacturers and exporters have tight grip on lending parties.
- When the supply is short the stockiest and traders play a big role in pricing
- Farmers becoming speculators, holding stocks.
- The Global customers support the prices.

Market Influencing Factors

Guar gum cultivation and its production are directly related to monsoon. The rainfall fluctuates between years and thus results in high volatility in production and consequently on prices. Some other factors influencing the market are-

- The physical market of the commodity involves speculators and stockists. The commodity is subjected to a long storage period based on demand and market prices.
- Government policies: There is no Governance to frame rules and regulations which govern the production, distribution, marketing, exports or imports of the commodity and the market forces determine the prices.
- Demand and supply mismatch
- Hoarding and black marketing

Limitation

- Guar is considered as a minor crop by the State Agriculture Departments and Agricultural Universities, who give more attention to crops like cereals, oil-seeds and pulses.
- Productivity is poor because farmers cultivate on marginal soils and hardly use any inputs. Good quality seeds and improved varieties are not available. Even farmers are not aware of varieties suitable for their area.

- Value-addition is poor. The pulverized gum is largely sold as a commodity. About 40% of the exports are still in form of refined splits.
- Lack of knowledge by the trade and industry. The industry's knowledge about the developments in agricultural research is poor.

Conclusion

- In the global market, India is in a dominant position with estimated share of about 80%. At present there isn't any competition. However there is a cut-throat competition amongst the exporters of India.)
- Production pattern of Guar is erratic as it is largely grown in rainfed areas.
- Good quality seeds, suitable for different agro climatic conditions should be made available.
- Suitable short duration varieties should be developed.
- Photo thermo- insensitive varieties should also be developed
- Guar should be promoted as an intercrop in annual crops.
- Concerted efforts in the area of agricultural research for guar i.e. plant breeding and agronomical practices should be undertaken.
- For the research on guar and extension activities it would be desirable for the industry to develop backward linkages.
- Special incentives could be given for export of branded (Indian brand) Guar products

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