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A REVIEW ON MULTIPLE USES OF CYAMOPSIS TETRAGONOLOBA (CLUSTER BEAN, GAUR)

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ABSTRACT

India is the leading producer of guar or cluster bean and guar gum in the world. It shares around 85 % production of the world, rest of major production comes from Pakistan. In India Rajasthan is leading producer of the guar seed and guar gum. It contributes around 70 % production of India. Haryana , Gujarat and Punjab are other Guar producing states in India. Guar, a modest bean so hard that it can crack teeth, has become an unlikely global player and become a crucial link in the energy production of the United States. In 2011, guar emerged as India's largest agricultural export to the United States, with sales of $915 million, according to a USDA Foreign Agricultural Service report. Broader commercial interest in guar was developed when food companies found to thicken ice cream and keep pastries crisp. This paper presents an overview of multiple uses of Gaur in various sectors.

Keywords: Endosperm, Galactomannan, Guar (Cyamopsis tetragonoloba (L.) Taub.), Guar gum, Pods

I. INTRODUCTION

From hundreds of years Guar has been used as vegetable in India and Pakistan. It is also used as cattle food, and as a green manure crop in agriculture. Guar gum comes from the endosperm of the seed of the legume plant *Cyamopsis tetragonoloba*; an annual plant, grown in dry regions of India as a food crop for animals [1] & [2]. In 2008, India accounted for 80% of the world trade of guar gum and guar seed was among the top 3 agricultural commodity traded on Indian bourses [3]. In the early 1900s it was introduced to United States by India. In U.S., most of the crop is grown for a lower grade of guar gum which is extensively used in the production process of many industries.

There are various grades of Guar gums pure or derivative. Guar gum is a white to creamy coloured, free flowing powder and free from extraneous matter. Its ability to suspend solids, bind water by hydrogen bonding, control the viscosity of aqueous solutions, form strong tough films have accounted for its rapid growth and use in various industries. For example *guar gum* is used in paper, textile, oil drilling, mining, explosives, ore flotation and other various industrial applications.

Guar (*Cyamopsis tetragonoloba* (L.) Taub.) is an erect, bushy annual herbaceous legume up to 3 m high, with trifoliate leaves up to 10 cm long, and white or rose coloured flowers. The pods are straight, hairy, pale green,

up to 12 cm long and contain 5 to 12 hard seeds (beans) each. However, the plant morphology is highly variable. Guar has a deep tap root system that can find moisture well below the soil surface [4].

Guar is a multi-purpose plant, mostly used today as a source of galactomannan gum, which is used as a thickener and stabilizer in foods such as salad dressings, ice cream and yoghurt. The gum and the water-soluble resin extracted from the seeds are also used in other industries, including paper manufacturing, cosmetics, mining and oil drilling [5]. The sweet and tender young pods are consumed as a vegetable or snacks in North-west and South India, and the mature seeds can be eaten during periods of food shortages. Young pods and fresh or dry forage are used as livestock feeds. The plant is also used as a green manure and cover crop. Guar yields up to 45 t/ha of green fodder, 6-9 t/ha of green pods and 0.7-3 t/ha of seeds [4] & [6].

Guar meal is the main by-product of guar gum production. It is a mixture of germs and hulls at an approximate ratio of 25% germs to 75% hulls [7]. A protein-rich material containing about 40% protein in the DM, it is used as a feed ingredient, but may require processing to improve palatability and remove antinutritional factors (Potential constraints were mentioned below). In addition to the regular guar meal ("churi"), some Indian manufacturers sell a high-protein guar meal ("korma").

II. DISTRIBUTION

Guar is mainly grown in the semi arid and subtropical areas of North and North-West India (notably in Rajahstan) and East and South-East Pakistan [1]& [8]. Guar does not exist in a wild state and is believed to have originated from an African species imported to India as horse fodder by Arabian traders (Ecoport, 2010). It later spread to other Asian countries, including Indonesia, Malaysia and the Philippines, and is now grown in many parts of the drier tropics and subtropics. Its value as a gum-producing crop was recognized during the second World War in the USA [5].

Guar is hardy and drought-tolerant. It is well adapted to arid and semi-arid climates with hot temperatures but can grow in sub-humid conditions, from sea level up to an altitude of 1000 m. Drought stops growth and the plant sprouts when rain resumes. It is grown without irrigation in areas with 250-1000 mm of annual rainfall and most seed production occurs in areas with less than 800 mm. However, guar responds well to irrigation during dry periods but does not tolerate waterlogging. Excessive rainfall and humidity affect fertilization, pod development and seed quality. In high rainfall areas, guar is more leafy and more suitable as a green manure and fodder crop. Guar grows well under a wide range of soil conditions and is tolerant of low fertiliy, soil salinity and alkalinity. It performs best on fertile, medium-textured and sandy loam alluvial soils but does not tolerate heavy black soils [5] & [9].

III. GUAR GUM CHEMICAL STRUCTURE:

Guar gum is a polysaccharide, a long chain made of sugars galactose and mannose. Some other familiar polysacharides are starch and cellulose, which are made of long chains of the sugar glucose. Guar gum is a galactomannan similar to locust bean gum consisting of a (14)-linked β-D-mannopyranose backbone with branchpoints from their 6-positions linked to α-D-galactose (i.e. 16-linked-α-D-galactopyranose). There are between 1.5 – 2 mannose residues for every galactose residue.

IV. GUAR GUM MANUFACTURING PROCESS

In India, *Guar gum* is normally undertaken by using process of roasting, differential attrition, sieving & polishing in the commercial production. The seeds of Guar are split and by sieving the endosperm and germ is separated from the endosperm. 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. Depending upon the requirement of end product various processing techniques are used.

V. GUAR GUM PROPERTIES

A guar gum manufacturer provides 8000 cps guar gum and essentially guar gum from India. Due to its various properties like easy solubility in both hot and cold water, water binding due to Hydrogen Bonding, fine film forming property, resistance to oils, greases & solvents, Best thickening action, Physiologically Inert nature, Non-ionic, Anionic or Cationic character etc., day by day new industrial applications of Guar gum are increasing for commercial uses.

VI. PROCESSES

(i). Guar gum processing:

In the manufacture of guar gum, the germ and the husks are removed by grinding and dry heating to obtain the guar "splits" (endosperm). The resulting by-product consisting of germs and husks, or guar meal, is used as a protein-rich feed material. The splits are subjected to various treatments including being hydrated, flaked, dried, finely ground and then purified, chemically processed and blended, to produce guar gums having specific properties, such as particle size, gel-making and water-binding abilities, as required by specific food and industrial applications [5] &[10].

(ii). Guar meal processing:

Several treatments, including enzymes (cellulase, hemicellulase, β-mannanase), heat treatments and fermentation have been proposed to improve the nutritive value of guar. Autoclaving guar meal can destroy the haemaglutinins and trypsin inhibitors but has little impact on the saponin and phytate contents [11].

VII. GUAR GUM APPLICATIONS

Guar gum is commonly used in Indian homes. Guar gum and its derivatives are globally used in various industries. Guar Gum is mainly used as a Natural thickener, Emulsifier, Stabiliser, Bonding agent, Hydrocolloid, Gelling agent, Soil Stabiliser, Natural fiber, Flocculants, Fracturing agent. Its domestic applications were mentioned here under:

- It is used as a vegetable for human consumption.
- For cattle feed and as a green manure crop.
- Guar gum is used in dressings, sauces, milk products, and baking mixes as it has almost 8 times the thickening power as cornstarch [1] & [12].

Industrial applications of Gaur gum were mentioned here under:

- Guar gum is used in paper manufacturing, textiles, printing, cosmetics and pharmaceuticals, oil drilling, mining and explosives as follows.
- In cosmetics industry it is used as thickener in toothpastes, conditioner in shampoos.
- In food industry Guar gum is used as Gelling, viscosifying, thickening, clouding, and binding agent. It is also used for stabilization, emulsification, preservation, water retention, enhancement of water soluble fiber content etc.
- In pharmaceutical industry it is used as binder in tablets.
- Guar gum is also consumed as a dietary fiber.
- In textile industry Guar gum is used in sizing, finishing and printing.
- In paper industry it is used to improved sheet formation, folding and denser surface for printing.
- In explosives industry Guar gum is used as waterproofing agent mixed with ammonium nitrate, nitroglycerin etc.
- In oil and gas drilling it is used as well fracturing.

7.1 Appliaction of Guar Gum in Oil and Gas Extraction

"Fracking," the common name for hydraulic fracturing is widely used to extract oil and gas, particularly from deep shale formations. In gum form, guar is the thickening agent used to push fluids sideways in the hydraulic fracturing or "fracking" process. Guar could stiffen water so much that a mixture is able to carry sand sideways into wells drilled by horizontal fracturing, also known as fracking.

"Farmers can earn 100,000 rupees [$1,875 USD] per hectare, which can yield 20 bags of guar beans," The fracking boom in the United States has led to a surge in natural gas production, a decline in oil imports and a gradual transition away from coal-fired power plants. Fracking become blessing to farmers of Rajasthan. While the U.S. hosts the world's most robust fracking industry, the Indian guar market is also benefiting from international demand for its use in the oil drilling method. As there is a demand for fracking fluids looks like it's here to stay. The U.S. Energy Information Administration projects U.S. natural gas production via hydraulic fracturing to increase from 21.6 trillion cubic feet in 2010 to 27.9 trillion cubic feet in 2035, a 29 percent increase. So there may be a great demand for gaur crop in future and the farmers of drought prone area could use this and may get benefitted.

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