KATIRĀ
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KATIRĀ (gum tragacanth), a plant exudate from *Astragalus* species, particularly *A. gummifer* and *A. microcephalus*, of the family *Leguminosae*, widely used as a natural emulsifier and thickener by the food, drug, and other industries (Mantell, p. 53). It is also called *ṣamḡ-e qannād* (lit. confectioner's gum; Dehḵodā, *Loḡat-nāma*, s.v. *katirā*). The English name tragacanth, derived from the Latin words *tragos* (goat) and *acanthus* (thorn), means "goat's thorn" (*Webster's Dictionary*). The thorny species of *Astragalus* are generally referred to as *gavan* in Persian, and the gum producing species as *gavan-e katirā*. This perennial bushy shrub has a large taproot and is native to arid temperate climate of Iran, Syria, and Turkey. It grows up to about one meter and its woody stems die back almost to the base each winter (Kiumarsi).

Gum tragacanth was known to Greek physicians from the seventh to fourth centuries B.C. (Gentry, p. 51). There have been two types of gum tragacanth in Iran, ribbon and flake. Each type is classified into several grades based on color, viscosity, and thickness of the exudates (Stauffer and Andon, p. 46; Davidson, pp. 11-17; Kiumarsi, p. 5). Only one type is usually produced at any location (Kirk and Othmer, p. 853). The flake type (Pers. *waraqi, ḵarmani*) is oval and brittle, with a thickness of 10 to 50 mm. The ribbon type (Pers. *maftuli*) occurs as curved fragments or as spirally twisted and linear pieces of 50 to 100 mm long and 1 to 2 mm thick. Large flakes and long ribbons with light color comprise the best grades. An off-white, aqueous solution of high viscosity without impurities indicates the best quality gum from Iran (Whistler and Bemiller, p. 290). The best commercial source of high quality gum is Iran

(Kirk and Othmer, p. 853; Anderson, p. 4). In the post-war decade, 1945 to 1954, the United States imported on average 998 metric tons of gum tragacanth per year from Iran, which was far more than from other countries combined (Gentry, p. 53).

To collect gum tragacanth, the soil around the plant is dug away from the taproot to a depth of 10 to 20 cm. This entails hard labor, especially because plants are widely scattered, which calls for considerable walking. The collar and lower stem are cut 2 to 5 cm long by a special knife, deep enough to open the gum cylinder. Some harvesters destroy upper leaves to accelerate gum exudation. The gum slowly exudes from the wounds, dries, and hardens. According to the collectors, the shape of dried gum depends on how the plant is cut. The best gum is obtained within ten days after cutting and from the first three collections. This process is repeated a few times during the gathering season from late May to September. Rain during harvesting season affects the quality of gum and may end the collection (Gentry, pp. 56-61).

Physicochemical properties. Gum tragacanth is a viscous, odorless, tasteless, partially water-soluble mixture of polysaccharides. An analysis of Iranian gum tragacanth from Fars Province consisted of three polysaccharide components of arabinogalactan (1.5 percent), bassorin (60 percent), and tragacanthic acid (36 percent); the latter two had similar structures (Kiumarsi, p. 172). The tragacanthic acid, with the backbone of galacturonic acid and its side chains of arabinose, xylose, galactose and fucose, is water-soluble and makes a thick jelly, but bassorin is not water-soluble and causes the jelly to harden and further thicken. Sugar composition varies among samples from different areas (Anderson and Bridgeman, 1988, p. 54; Anderson and Grant, p. 422). Gum tragacanth contained 12-15 percent moisture, 3-4 percent minerals, 0.4 percent nitrogen, and 1 percent calcium (Kiumarsi, p. 43; Mohammadifar et al., p. 34).

Viscosity or resistance to flow of a solution of gum tragacanth is higher than any other plant gum (Glicksman, p. 121; Aspinall, p. 458; Kirk and Othmer, p. 853). Its viscosity decreases by elevated temperature and reverts upon cooling (Stauffer and Andon, p. 48; Davidson, pp. 11-19). Mechanical grinding of dry gum leads to molecular cleavage, and thus a solution made from powder is less viscous than that from large pieces of gum with the same concentration. A one percent solution of ribbon type gum is three times more viscous than flake, while flake shows superior interfacial tension reducing and emulsion properties compared to ribbon (Stauffer and Andon, p. 46). Unlike other gums, gum tragacanth does not degrade in low pH systems and requires no surfactants to lower the resistance between oil and water.

Usage. Gum tragacanth has been extensively used as an emulsifying, thickening, and suspending agent in food and pharmaceutical industries. Its desirable properties include high viscosity at low concentration, stability to heat and acidity, resistance to microbial degradation, and very long shelf life (Davisdon, pp. 11-13; Gavlighi, p. 12). It is used as moisture retainer, anti-freezing agent, and preserver in dairy and bakery products (Aspinall, p. 461; Davidson, pp. 11-18). Gum tragacanth is listed in the United States Pharmacopoeia (1970), Food Chemicals Codex (1966) and is considered "generally recognized as safe" under the Federal Food, Drug and Cosmetic Act. It is also classified as "acceptable daily intake not specified," which is the highest category of safety evaluation (Anderson and Bridgeman, 1985, p. 2301; Idem, 1988, p. 51; Anderson and Grant, p. 417).

Gum tragacanth facilitates the absorption of poorly soluble substances in medicinal products and acts as adhesive in pills and tablet production (Aspinall, p. 461). It is used as a suspending agent to prevent the material from settling out and as a stabilizer for vitamin C (Davisdon, pp. 11-20). It is widely used in a variety of products including lotions, jellies, dyes, polishes, insecticides, printer paste, printer's ink, crayon, glue, culture media and various cosmetics (Whistler and BeMiller, p. 293; Davidson, pp. 11-18; Aspinall, p. 461).

Annual production of gum tragacanth in Iran drastically fell during the 1980s, from several thousand tons to 200-300 tons, due to the Iran-Iraq War and the Iranian government's price-fixing policy that made it a non-competitive item (Anderson, p. 4). Meanwhile, gum tragacanth is often highly contaminated with microbiological factors, compared to substitute gums such as xanthan. Xanthan gum, a fermentation-derived product, became a cheap and readily available substitute for gum tragacanth, especially because xanthan is virtually sterile as a result of its manufacturing process. Gum tragacanth, however, remains superior in functionality compared to xanthan gum (Anderson, p. 5).

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