

DOMESTIC GOAT AS A DRUG FACTORY

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In England, the Jamunapari goat was bred with local breeds to produce the Anglo-Nubian.

The domestic goat (*Capra hircus*) is a familiar presence in the rural landscape of India and in many developing countries. The goat has played an important economic role in human communities from the time it was domesticated about 10,000 years ago. It has even been argued that the domestication of goats was an important step in mankind's shift from a hunting-gathering lifestyle to agricultural settlements.

The Food and Agriculture Organisation (FAO) estimates that the world has 830 million goats belonging to about 1,000 breeds. India has 150 million from over 20 prominent breeds. Rajasthan has the most number of goats — the Marwari goat found here is hardy and well-adapted to the climate of deserts. Another hardy breed, found in the dry regions of Maharashtra, Telangana and North Karnataka is the Osmanabadi.

The Malabari (also called Tellicherry) of North Kerala is a prolific breed with low-fat meat, and shares these traits with the beetal goat of Punjab.

The east Indian Black Bengal goat is a vital contributor to the livelihoods of the rural poor of Bangladesh. It contributes over 20 million square feet of skin and hides to the world's demands for leather goods, from firefighters' gloves to fashionable handbags. As many farmers lack the space or funds to rear cattle, the goat is rightly called "the poor man's cow".

Indian highlands have scant populations of wild goats, from which domestic goats or sheep have evolved. These include the *markhor* and the Himalayan and Nilgiri tahr.

Genes from Indian goat breeds spread to all parts of the world during the golden age of steamships. Goats laden on ships heading to Europe from India provided milk and meat on the months-long journey. The Jamunapari goats of Uttar Pradesh were favoured as they yield 300 kg of milk during eight months of lactation. Once in England, the Jamunapari was bred with local breeds to produce the Anglo-Nubian, a champion producer of high-fat milk.

With a generation time of about two years, and plenty of milk production, it is not surprising that goats have attracted the attention of biotechnology companies wishing to produce therapeutic proteins in bulk.

The first success came with ATryn, the trade name for a goat-produced antithrombin III

molecule. Antithrombin keeps the blood free from clots, and its deficiency (usually inherited) can lead to serious complications such as pulmonary embolisms. Affected individuals need antithrombin injections twice a week, usually purified from donated blood.

Transgenic goats carrying a copy of the human antithrombin gene have cells in their mammary glands that release this protein into milk. It has been claimed that one goat could produce antithrombin equivalent to what was obtained from 90,000 units of human blood.

Recently, the monoclonal antibody cetuximab, which has been approved by the FDA as an anti-cancer drug against certain lung cancers, has also been produced in cloned goat lines. Large quantities can be made this way (10 grams per litre of milk). It is not yet known whether this 'Farmaceutical' will clear regulatory hurdles regarding safety and efficacy. Will other monoclonal antibodies be produced some day in large quantities using goats as drug factories?

(The article was written in collaboration with Sushil Chandani, who works in molecular modelling. sushilchandani@gmail.com)

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