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Foot-and-Mouth Disease: A Serious Threat for Dairy Industry

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Abstract

Harm from animal diseases has threatened farmers since farming began. The damage can be economic (loss of output, income and investment) and psychological (shock and panic). Combating livestock diseases is a necessity for the farmers. The present article outlines the drastic effects that foot-and-mouth disease (FMD) can have on the dairy industry in any country in the world. FMD is a large potential threat to the health and economic productivity of this industry. It is highly infectious and spreads rapidly through a population of susceptible dairy animals. An outbreak will result in severe economic consequences to dairy producers and the processors and the country as a whole.

Introduction

Agriculture acts as the single largest contributor to the livelihoods of 75% of the world's poor. Out of 2450 million people across the globe involved in agriculture, probably two-thirds or even three-fourths are solely dependent upon livestock farming. The livestock production and agriculture are complementary to each other in Indian scenario. Livestock sector plays a vital role in providing nutritive food and family income, generates employment among the landless, small, marginal farmers and women, thereby acting as a dependable 'bank on hooves' in times of need. This sector plays an immense role in the socio-economic development of India's rural population. Dairy farming has been a very important component of the age-old farming system of the country, and is one of the significant means of providing livelihood and nutritional security to the majority of rural masses. Around 70 million rural households are engaged in dairy farming in India. Presently the country is producing 112.5 million tones of milk. Livestock in total contributes 3.93% of national GDP and 22.14% of the agricultural GDP. The contribution of milk in national economy is higher than any other agricultural commodity. The rapid growth of livestock sector benefits the poorest households the most because livestock contributes nearly half of the total income of the smallholders. Milk provides relatively quick returns for small-scale livestock farmers. India ranks first with respect to buffalo, second in cattle and goats, third in sheep population in comparison to the world livestock population. Indian dairy farming has put the country to be the world's leader in milk production contributing 15.7% of the global milk pool.

Animal diseases constrain the nation's milk production leading to loss of thousands of million rupees annually. Foot-and-mouth disease (FMD) is the most economically devastating animal disease that has frightened farmers since the 1500's. All cloven-footed animals including cattle, buffaloes, sheep, goat, pigs are susceptible to the disease. Its wide host range

and rapid spread along with cause of severe economic loss represent an international concern. For obvious agricultural reasons, the disease is more important in cattle, buffaloes, bulls and bullocks in India. Even one case of the disease in a nation is enough for other countries to close their borders to animals or animal products from the infected nation. This paper briefs the drastic effects that FMD can have on the dairy industry in any country in the world.

Causative Agent and Survivality

FMD is caused by a single-stranded RNA virus belonging to the genus *Aphthovirus*, in the family *Picornaviridae*. Three serotypes O, A, Asia 1 are prevalent in India. Some reports indicate the FMD virus (FMDV) has been recovered from cattle stalls 14 days after removal of infected cattle, from urine after 39 days, from soil after 28 days in autumn, after 3 days in summer, and from dry hay at 22 °C after 20 weeks of storage. Other reports indicate the virus can survive one month in frozen bull semen, 50 days in water, 35 days on cardboard, wood or metal contaminated with serum or blood.

Disease Transmission

On an average, the incubation period for FMDV varies from 3 to 7 days. Different animal species react to FMD in different ways. Sheep and goats are considered maintenance hosts as they produce mild clinical signs. Pigs are amplifying hosts as they concentrate the virus in their respiratory secretions. Cattle are indicator hosts because they most often show clinical signs with more severe lesions. Transmission primarily occurs through respiratory aerosols, direct contact with infected animals, oral consumption, or through contaminated fomites. The virus can survive for 1-2 days in the human respiratory tract, thus they can spread virus to animals. Contaminated foods were the cause of outbreaks in the United Kingdom (UK) and Taiwan, costing billions of dollars. Reproductive spread can occur through infected semen used for artificial insemination (AI). Infection may spread either through infected feed and fodder, infected utensils, and infected means of transportation or, through animal caretakers. However, the wide spread of infection results from congregation of animals in cattle fairs or cattle markets.

The Role of Milk and Dairy Products in the Epidemiology of FMD

Milk and dairy products are very important commodities for trade. Ample evidence suggests that the movement of infected raw milk has played an important role in the spread of FMD during outbreaks. Cattle, and other milking animals, such as goats and sheep, can excrete the virus in their milk for several days before the apparent clinical signs of the disease. An infected cow can

excrete 1 million infectious doses of virus per ml of milk. The feeding of raw infected milk to susceptible animals can cause transmission. The most common transmission pathway is the consumption of contaminated milk fed to pigs or calves. The unpasteurized milk is a well-recognized vehicle for the spread of FMD, particularly during outbreaks. Products made from raw milk are potential vehicles for the spread of FMD. The 1967-68 UK epidemic stimulated a fresh impetus for both epidemiological studies on the role of milk in FMD. Movement of milk was involved in the spread of FMD during the 1967-68 epidemic in UK. Primary movement of raw (untreated) milk was a major hazard in spread of disease. The 'Crewe episode' during the 1951-52 epidemic in UK indicates that feeding of infective milk to calves in transit led to 101 new outbreaks. During the 1967-68 UK epidemic, 22 subsequent outbreaks resulted from the collection of milk from 25 infected premises. During the Denmark epidemic in 1982, 5 outbreaks occurred due to infected milk. FMDV has been shown to survive in whole milk heated at 72 °C for 5 minutes, but gets inactivated at 148 °C for 2-3 seconds or longer. Research has shown that the virus survives up to 93 °C for 15 seconds in cream and buttermilk. FMDV in cheddar cheese made from unpasteurized milk do not survive more than 4 months. Heating to 138 °C for a minimum of 1 second will inactivate FMDV in milk.

Disease Transmission Associated with Milk Containers

The hazards associated with bulk milk tanker during the 1967-68 UK epidemic and 1982 Denmark epidemic were analyzed. Epidemiological links were found between the routes taken by bulk milk tankers and the spread of FMD during both the epidemics. There are possibilities of FMDV being spread by aerosols produced by bulk milk tankers exhausting air from the tanker space. Milk tankers can also mechanically transfer infective material. Tanker drivers, herd testers, inseminators and other dairy farm visitors are most likely to be contaminated with the virus if they have handled infected animals. Milk tanker spread was implicated in 3 of 22 infected premises during FMD epidemic in Denmark in 1982. Milk tankers were the reported cause of spread for 0.7% of FMD outbreaks in the 1967-68 epidemic and 0.6% of outbreaks in the 2001 epidemic in UK.

Devastating Effects of FMD on Dairy Industry

FMD severely affects the economy of a country. Historical examples state that the cumulative loss of an incursion of FMD on New Zealand's economy was estimated to be \$6 billion in the first year, rising to \$10 billion by the second year. Costs of the outbreak of FMD in the UK in 2001 were £3.1 billion in losses to agriculture and the food chain and 20% of

the estimated total farming income for 2001 (£355 million). In the 2001 UK outbreak, 2.5 million animals were slaughtered that was the largest slaughter category in the outbreak. Italy's 1993 outbreak cost over \$130 million, and the 1997 Taiwan outbreak cost roughly \$15 billion. FMD in cattle causes fever, depression, excessive salivation, lameness and formation of vesicles or erosive lesions on mucous membrane of the tongue (Figure 1), dental pad (Figure 2) and gums, muzzle, inter-digital spaces (Figure 3). Vesicles/ erosions also develop in the skin of udders and teats (Figure 4) of lactating cows in which milk yield drops dramatically leading to mastitis after secondary pathogen invasion. Besides, FMDV also exhibits pathology in some of the vital endocrine glands controlling the body metabolic processes. Disordered functioning of heat regulating centers leading to panting is one example. The direct costs of disease management account for the cost of vaccination, slaughter, disposal and cleaning, disinfecting and administrative costs. The indirect effects are loss of production functions during the acute phase of disease, loss of milk yield on a permanent basis, loss of breeding capacity including



Figure 1: Severe erosive lesion in tongue of FMD affected cattle



Figure 2: Ruptured blister in dental pad of FMD affected cattle



Figure 3: Ruptured vesicles with erosion in inter-digital space of FMD affected cow



Figure 4: Erosive lesions in the teats of FMD affected cow

abortions, infertility, loss due to reduced draught capacity in working bullocks, loss resulting from temporary cessation of AI programmes, mortality in young calves due to heart failure, flare up of inter-current infections like theileriosis and anaplasmosis, loss of export markets in animal products. Animals with FMD usually recover uneventfully and may experience chronic mastitis, poor growth, and permanent hoof damage.

Conclusion

In conclusion, FMD is highly infectious and spreads very rapidly in susceptible dairy animals. An outbreak will result in devastating economic consequences to the dairy industry. As already stated, India presently ranks first in the milk production. The total projected demand of milk by the year 2030 would be about 200 million tones, which amounts to an annual increase of around 4 million tons during the next two decades. To meet this projected demand, the rate of milk production must be accelerated. We should prevent and control FMD that stands in the way of such target. It is reported by NSSO in 2005 that given alternative options,

40% of the farmers would leave farming, which indicates an eroding confidence of farming community in agriculture. This must be restored by increasing agricultural productivity and income of the marginal and small farmers whose economic viability is progressively threatened. To meet the national

demand, concerted efforts in terms of better health and disease control strategies are required to exploit the animal sector maximally. Unless we make sincere efforts to prevent and control FMD, we will be far away from the targeted milk production of 200 million tons by 2030.