Neurological disorder in dairy cattle associated with consumption of beer residues contaminated with *Aspergillus clavatus*

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Abstract. A neurological syndrome in dairy cattle associated with consumption of moldy beer residues is described. The disease occurred on 1 farm in late June 2001, during winter. Six heifers and 1 cow out of 45 cattle were affected during a 3-week period. The affected animals died spontaneously or were euthanized approximately 2–14 days after the onset of clinical signs. The clinical signs were characterized by flaccid paralysis and gait abnormalities. Clinical signs were more pronounced after exercise and included stiff and unsteady gait, knuckling at the fetlocks of the hind limbs, frequent falling, inability to rise, muscular tremors, especially of the head and the hindquarters, and drooling. Main necropsy findings included degenerative and necrotic changes of the larger medial muscle groups of the hindquarters, i.e., adductor, pectineus, quadriceps femoris, rectus femoris, sartorius, semimembranosus, semitendinosus, and vastus medialis, and of the forequarters, including pectoralis descendens, pectoralis ascendens, and transversus pectoralis. The main histologic findings consisted of degenerative and necrotic neuronal changes (chromatolysis) of varying severity and extent affecting selected nuclei of the brainstem and neurons of the ventral horns of the spinal cord. Similar microscopic lesions were observed in the neurons of the spinal cord of 1 experimental sheep force-fed for 35 days with 1 kg/day of the same batch of foodstuff that was originally fed to the cattle. coarse white or gray lumps, interpreted as mycelia, were observed in the beer by-product. *Aspergillus clavatus* was the dominant fungus isolated. Deaths ceased after the consumption of beer residue was discontinued. Recovery from illness was observed in 1 animal. The diagnosis was based on epidemiological data, clinical signs, necropsy findings, histological lesions, dosing trial, and mycology. A similar condition caused by consumption of barley by-products, sprouted wheat, corn sprouts, and beetroot screenings contaminated with *A. clavatus* has been reported in cattle and sheep worldwide.

Barley-based feeds have been commonly implicated in the occurrence of metabolic disorders in cattle such as ruminal acidosis and laminitis because these feedstuffs have a relatively rapid fermentation rate.20 In addition, malting by-products from brewing and distilling industries have been associated with a tremorgenic syndrome in cattle and sheep.10,12 Sorghum beer residues, sprouted wheat, corn sprouts,10,12 and beetroot by-products21 also have been reported to cause a similar neurological condition in ruminants. There are reports of sporadic outbreaks of this nervous disorder worldwide.7,10,12,14,16,21,24,27,30 These episodes have been linked to contamination of foodstuffs by toxic strains of *Aspergillus clavatus* because in these outbreaks saprophytic fungus or its mycotoxins (or both) have been frequently isolated from feed supplements.10,12

*Aspergillus clavatus* is known to produce several toxic metabolites that are selectively neurotoxic to animals and human beings.12 These mycotoxins are referred to as tremorgenic metabolites, and patulin is the most frequent mold metabolite isolated from contaminated foodstuffs. Other neuromyotoxins produced by *A. clavatus* include tryptoquivaline, tryptoquivalone, nortryptoquivalone, cytochalasin E, cytochalasin K, escladiol, and clavatol.7,12,17 However, in many instances, efforts to demonstrate the presence of the fungus in foodstuffs were unsuccessful, and attempts to isolate tremorgenic mycotoxins from food supplements have failed or have not been made.10,12 It is worth mentioning that patulin is a mycotoxin synthesized by many fungi other than *A. clavatus*. Patulin is reported to be produced by molds belonging to several genera, including *Aspergillus, Byssochlamys, Gymnoascus, Paecilomyces*, and *Penicillium*.10,12,29

*Aspergillus clavatus* poisoning in livestock linked to consumption of contaminated foodstuffs has been included in the group of acquired tremorgenic syndromes associated with ingestion of biologic tremorgens of fungal or plant origin.13,14,27 The clinical signs

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