The use of ammonium chloride in falconry in the Middle East

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AMMONIUM chloride (NH₄Cl) or ammonium muriate is an inorganic salt, commercially available as hygroscopic colourless crystals or as a white crystalline powder with a cool saline taste. The LD₅₀ in the rat is 1650 mg/kg. Its application in both human and veterinary medicine is primarily for acidifying the urine and increasing the rate of urine flow, but it is also widely used as secretory expectorant and cilia augmentor. This is probably achieved by increasing directly or indirectly the beat frequencies of the cilia in the respiratory tract, but the exact mode of action or the mechanism involved is poorly understood (Brander and others, 1991).

Following ingestion in domestic animals and man, ammonium chloride is metabolised in the liver and converted into urea and hydrochloric acid, resulting in severe acidosis. Excretion takes place via the urinary pathway (Gilman and others, 1985). Birds are uricotelic, excreting the end product of nitrogen metabolism as uric acid. This is synthetised in the liver and excreted by glomerular filtration, but mainly by tubular secretion (King and McLelland, 1984). Thus in mammals, and presumably in birds, when a high dose of ammonium chloride is administered orally or in the presence of liver insufficiency, acute hyperammonaemia is experienced. As a result, the levels of NH₃ are too high for the liver detoxifying capacity, acting subsequently as a cytotoxic agent mainly in the brain. Sometimes and depending on the dose...
ingested and the digestive process, carbamates appear as toxic metabolites, acting as reversible inhibitors of cholinesterase (Forth and others, 1983).

In the Middle East, ammonium chloride is best known as "Schnather", an Arabic word widely used by falconers and by the people engaged in the trade of traditional Arab medicine, who normally sell it in the form of crystals.

During the initial phase of the hunting period (November), a considerable number of falconers in the Gulf routinely administer ammonium chloride to the falcons under their charge, with the aim of improving their hunting ability. There are other falconers who will administer ammonium chloride to a particular bird which failed to kill or did not show interest in its prey during the first hunting trip. The method normally requires two handlers, one for casting the falcon and the second for forcing a small (10 to 25 mm diameter) crystal of ammonium chloride down into the crop of the immobilised bird. As an alternative, it is also a common practice to wrap several small crystals of ammonium chloride in a piece of cotton cloth, forming a small sac and tied at one end with a piece of thin string about 25 cm long. So when the small sac is forced fed, the other end of the string is left protruding from the mouth so it can be used to retrieved the sac after a few minutes. The theory behind this procedure is that the chemical action of ammonium chloride will remove, "the fat deposits within the stomach", resulting in a hungrier bird and therefore more interested in hunting.

Two or three minutes after the administration of the ammonium chloride, the falcon usually vomits violently bringing up large quantities of a thick green-yellow mucus, sometime with whitish strands and the partially dissolved crystal. Nevertheless, falconers are very familiar with the toxic effects of this substance and they know quite well, probably from previous painful experiences, that if the bird is not able to vomit the ingested crystal within five to 10 minutes, the falcon will
undoubtedly die. In this respect, the authors (J.H.S. and T.A.B.) have witnessed the death of several individuals within 15 minutes following ingestion. Sometimes, a large ingested crystal breaks down into smaller fragments within the crop, resulting only in the partial vomition of the ammonium chloride crystal originally swallowed, an event that usually goes unnoticed by the falconer. In this case, the bird soon becomes lethargic and anorexic, loses weight rapidly and begins passing characteristic dark metallic-green mutes. During the terminal phase, the bird is unable to stand on its block, remaining on the floor most of the time and the breathing becomes dyspnoeic. This is followed by a short period, usually 4 to 8 hours, characterised by fits and opisthotonos followed by death. The clinical signs develop over three to seven days, depending on the total amount of ammonium chloride ingested, although there have been occasions in which the bird dies up to two weeks later.

During 1987 to 1993, the Sulman Falcon Hospital in Bahrain received a total of 35 falcons for treatment displaying toxic-related clinical signs. Thirty birds were positively identified as intoxicated with ammonium chloride as confirmed by the clinical history. The remaining five birds died while being treated at the hospital for either bumblefoot or avian pox. These birds showed clinical signs related to ammonium chloride toxicity and died, some of them within 12 hours of the onset of the toxicity-related clinical signs. Later it was discovered that these birds had been maliciously poisoned. The toxic agent involved was not known until comparative studies with the other 30 birds were carried out and the results suggested that ammonium chloride may have been involved in those incidents. Fatalities included 30 saker (Falco cherrug), two peregrine (Falco peregrinus) and three gyr falcons (Falco rusticolus). Post-mortem examination was only possible in 12 individuals, including eight sakers, one peregrine and three gyr falcons.

Gross pathological changes observed at post-mortem examinations of affected birds included generalised congestion of the mucosa and the presence of dark metallic
green mucus along the entire digestive tract. The liver was friable and of a uniform dark, metallic-green colour. The kidneys showed mild perirenal oedema and mild to severe cortical and medullary congestion. Histopathological findings were non-specific. The livers showed moderate to severe congestion and golden-brown pigment (possibly haemosiderin) within Kupffer's cells and macrophages. Other lesions were variable. In some birds these included perivascular cuffing by plasma cells and other mononuclears. Subcapsular and also well scattered, small foci of early, coagulative necrosis and vacuolation of the hepatocyte cytoplasm were also found. Sometimes the necrosis was associated with mononuclear cell infiltration. It is possible that some of these lesions were secondary to bumblefoot. The kidneys showed mild to severe tubular nephrosis. Many tubules were dilated and/or partially occluded with acidophilic or slightly basophilic amorphous material, probably due to urate nephrosis.

Ammonium chloride is widely used by falconers in the Middle East (A. Ashour, P. McKinney, D. Remple, K. Riddle, F. Al-Timimmi, personal communication) and may account directly or indirectly for up to 25% of all falcon deaths during the hunting season in veterinary hospitals in the area (Samour, unpublished data). As this significant number of falcons die every year, the need to propose effective alternatives to Arab falconers is essential.

From Medieval times, falconers in Europe have known that falcons in captivity ingest small stones, normally referred to as "rangle", and that these are cast out one or two days later. They firmly believed that these stones "stir mucus and fat in the stomach" (Latham, 1615). He even proposed that "wash'd meat and stones maketh a hawk to flie, but great casting and long fasting maketh her to die".

Fox (1976) highlighted the importance of making available stones of adequate size to falcons. The beneficial effect of ingesting and casting these stones should not
be underestimated, as very often stones are found in the gizzard of birds of prey during post-mortem examinations or are detected radiologically (Cooper, 1978). Moreover, the use of "range" by birds of prey in the wild is well known. In this respect, different species of birds of prey have been observed ingesting "range" in various countries around the world, including European (Falco tinnunculus), Mauritius (Falco punctatus) and nakeen kestrels (Falco cenchroides), merlins (Falco columbarius), New Zealand (Falco novaeseelandiae), peregrine and gyr falcons, common buzzard (Buteo buteo), and golden eagle (Aquila chrysaetos) (Fox, personal communication) The use of "range" on hunting falcons in the Middle East could prove an alternative to the use of ammonium chloride.

The biochemical action of ammonium chloride as an acidifier may be responsible for the stimulation of appetite at the central nervous system level. In domesticated animals, it is known that groups of neurons in the lateral hypothalamus promote the drive for hunger and that noradrenergic and cholinergic transmitter systems are also implicated in the stimulation of appetite (Klemm, 1984). Probably and perhaps more correctly, ammonium chloride may be responsible for a chronic chemical irritation of the hunger terminals in the upper digestive tract. In falconiformes, the taste buds are located on the base of the tongue. There are 30 or 40 axons connecting each taste bud to the central nervous system through the glossopharyngeal nerve (King and McLelland, 1984). The autonomic terminals in the crop, oesophagus and gizzard may also be stimulated by this chemical action, sending constant messages of hunger to the hypothalamus.

Falconers often report that following administration of ammonium chloride, the falcon looks more alert during hunting and is hungry all the time. It is difficult to assess the validity of this statement, but despite its apparent favourable response, ammonium chloride remains a highly toxic agent responsible for the death of a significant number of falcons.
Alternatively, "rangle", may be directly responsible for the mechanical stimulation of hunger in the upper digestive tract. The stones in the crop and gizzard may play the role of "stimulus" responsible for triggering the reflex of appetite at the hypothalamus level, as described by Klemm (1984).

The use of "rangle" in falconry in Middle Eastern countries might prove effective reducing such high mortality amongst falcons every year. Veterinarians working in the region have the responsibility of educating falconers on the application of preventative medicine programmes and good husbandry practices to ensure health in hunting falcons.

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