

Oxidative effects of long-term onion (*Allium cepa*) feeding on goat erythrocytes

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Abstract Toxic compounds such as disulfides of onions cause oxidative-induced haemolysis in several animal species. In order to study the outcomes of long-term onion consumption on some oxidative haemolysis markers, 12 adult female goats were allocated to three groups, receiving 0% (served as control), 30% (dry matter basis) and 60% spring-grown onion for 60 days. Blood samples were obtained before feeding the onion and every 10 days up to 80 days for measuring malonyldialdehyde (MDA), methaemoglobin (MetHb), mean corpuscular fragility (MCF), serum-free haemoglobin and serum lactate dehydrogenase (LDH) and for evaluating their relation to packed cell volume (PCV) and haemoglobin (Hb) concentrations. PCV and Hb concentrations reduced, however, remained within reference ranges in onion-fed goats. MetHb showed a significant negative correlation with both PCV and Hb ($P < 0.05$) in onion-fed goats and a significant positive correlation with MCF and serum-free haemoglobin in goats receiving 30% onion. MetHb showed a significant positive correlation with MCF in goats fed with 60% onion. MDA showed a positive correlation with LDH and serum-free haemoglobin concentrations. These results suggest a role for oxidative damage in destructing red cells in goats feeding onions. However, it seems that up to 60% onions in diet can be consumed by goats without noticeable clinical anaemia.

Keywords Oxidative damage · Erythrocytes · Onion · Goat

Introduction

In areas where onions are grown commercially, it is a common practice to use culled onions as a source of feed for livestock (Crespo and Chin 2004). Naturally occurring as well as experimentally induced onion poisoning has been reported in different animal species (Hutchison 1977; Verhoeff et al. 1985; Carbery 1999; Rae 1999; Van Der Kolk 2000; Van Kampen et al. 1970; Kirk and Bulgin 1979; Aslani et al. 2005; Pierce et al. 1972; Stallbaumer 1981; Solter and Scott 1987; Kobayashi 1981; Crespo and Chin 2004; Harvey and Rackear 1985; Fredrickson et al. 1995; Robertson et al. 1998; Selim et al. 1999; Figuera et al. 2002).

Plants of the *Allium* family such as onions contain methyl- and prop-(en)ylcysteine sulfoxides. When the plant tissue is disrupted, these substances are degraded to thiosulfates. After eating, thiosulfates break up to mono-, di-, tri- and tetrasulfides (Munday and Manns 1994). Many of these compounds are responsible for the toxic and pharmacologic effects of these plants.

Onion toxicosis has been associated with oxidative haemolytic anaemia and formation of Heinz bodies in the erythrocytes, eccentrocytosis and methemoglobinemia (Borelli et al. 2009). Heinz bodies and eccentrocytes increase erythrocyte fragility and extravascular haemolysis. Direct oxidative damage to the erythrocyte cell membrane or the oxidative production of hemin also contributes to cell lysis (Harvey 2008). Thus, the result of the oxidative haemolysis induced by onion consumption is development of anaemia, Heinz bodies, eccentrocytosis, haemoglobinemia, haemoglobinuria, hyperbilirubinemia, methemoglobinemia, increased LDH in blood serum and increased osmotic fragility of erythrocytes. In addition,

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