Quality of groundwater used for poultry production in the Western Cape

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Abstract

Water samples were collected from 35 boreholes at poultry producers in the Western Cape and were analysed for 43 mineral and trace element constituent inclusion levels.

Bicarbonates, chlorides, fluoride, nitrates, phosphates, sodium, cadmium, iron, lanthanum, lead, manganese, mercury, titanium and zirconium were identified as potentially hazardous constituents (PHC) in some areas and bicarbonates, chloride, sodium, lanthanum, lead, mercury and zirconium were identified as constituents of concern (COC) in some areas.

Introduction

Knowledge regarding water quality is important for poultry production as it affords the producer with the managerial information required to prevent the potential adverse consequences attributed to specific concentrations of water quality constituents. These typically pertain to health and production parameters, the quality of the livestock product and the watering systems used in intensive poultry production systems. Meyer, Casey and Coetzee (1997) reported that there is no national database on the water quality constituent profile of water sources utilised for livestock production. They suggested that a water quality monitoring system be formulated in which the relevant water quality constituents for the specific areas and production systems be identified, primarily based on the potential for adverse effects and their occurrence in the natural aquatic environment. Existing information lacks analyses for critical constituents and site-specific information, required to formulate a risk assessment. Analyses are often not standardised with the result that information on constituents that may affect the usability of the water source may be left out.

The Western Cape region west of the Hottentot Holland mountain range is highly urbanised and industrialised and is farmed intensively. The farms include some of the country's biggest poultry units, which collectively deliver 24.5% of the gross egg production and 27.1% of the gross broiler production (Liebenberg et al., 1996) of South Africa. The physiography is a dominance of fold mountains, which affect the spatial distribution of rainfall and results in a high runoff. The potentially precarious water supply and the high demand for water for the urban areas, industry and agriculture, has caused many producers to rely on, or supplement, their water from subterranean sources. The characteristics of the subterranean water may vary substantially (Hem, 1979), and in southern Africa this is largely due to the occurrence of fractured aquifers (Parsons and Tredoux, 1993).

Interim water quality guidelines published in 1996 by Casey and Meyer, have been surpassed by a water quality guideline index system, termed CIRRA (constituent ingestion rate risk assessment) (Casey et al., 1998). The system, described by Meyer (1998), utilises a modelling approach, taking into account the type of livestock and production system, the environment and the ingestion rate of single or multiple water quality constituents to identify potentially hazardous constituents (constituents in excess of recommended guidelines) and constituents of concern (constituents within 10% of the recommended upper limit), which are then used to formulate a risk assessment on a metabolic basis. The CIRRA system is functional for cattle, sheep, horses, swine and goats, but the component for poultry is under development.

The growth and health of poultry depend on a multitude of factors. These factors have been shown to be interdependent. This is another way of saying that a certain level of water constituent may not affect a bird's performance in one environment while it could cause a problem in another (Ralph, 1989). Recent studies (Coetzee et al., 1997 and Casey et al., 1998) have evaluated the effect of some water quality constituents on layers and broilers under practical flock conditions. They found that hens receiving 6 and 20 mg/ℓ of added fluoride had a significantly lower egg production rate. Fluoride significantly influenced the water intake of the hens. The hens receiving 6 and 20 mg/ℓ of added fluoride drank significantly more water.

These statistics highlighted the fact that there are inadequacies in existing water quality guidelines. Different species have different tolerances to different water quality constituents, exposure times and the ingestion rates of the constituent. Some poultry water quality standards have been derived from work on large animals. Others are based on poultry mortality rather than the effects on growth, reproduction or other production measures (Carter, 1985).

This paper reports on the quality of water used by poultry producers in the Western Cape. The objective was to identify PHCs (constituents in excess of the recommended guidelines) and COCs (constituents within 10% or the recommended upper limit) according to Meyer (1998) for poultry producers, in order to establish the validity of water quality guidelines currently in use for poultry, and to identify constituents which may require further investigation regarding potential hazards for site-specific poultry production on a site-specific basis.

Procedures

Geographical location and borehole selection

The area visited in the Western Cape is situated in a zone 17 to 19° longitude and 32 to 34° latitude (see Fig. 1). Poultry producers were

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