A novel approach to analytical mineral analysis in the diagnosis of animal health

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Introduction

Minerals are nutrients that are essential for maintaining biological life. In animals they perform structural, physiological, catalytic and regulatory functions [1]. However when mineral deficiencies or toxicities occur this can greatly impact animal health. Therefore it is important that these occurrences are diagnosed quickly to safeguard animal health.

Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is an analytical technique that can determine the elemental make-up of samples. It is used in many different applications worldwide except in the analysis of clinical samples to assist in veterinary diagnosis . It is this application of ICP-OES which highlights the novel value of this research.

Aims and objectives

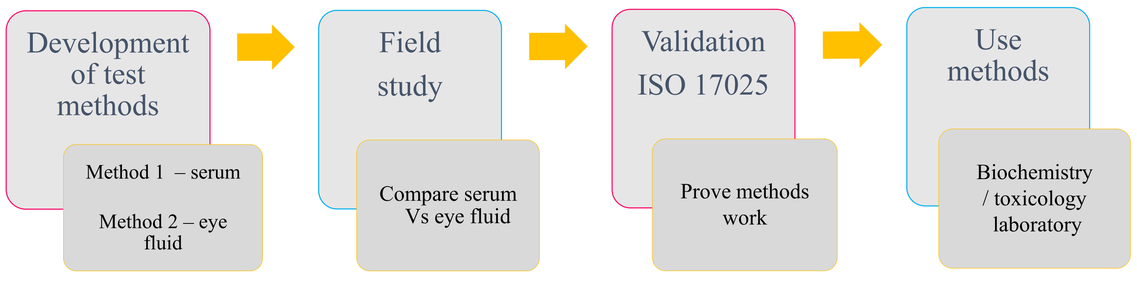

Figure 1: Summary of research aims and objectives

Methods

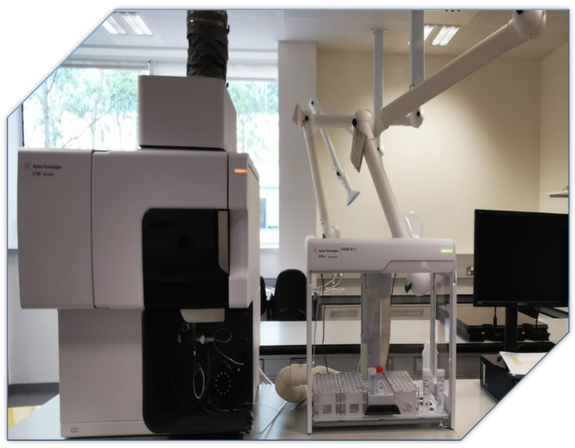

Figure 2: Agilent 5100 VDV ICP-OES

An ICP-OES instrument is used for this project coupled with a automated sampling unit and operated by a PC control.

The instrument is state-of-the-art and equipped with the latest smart software allowing for instrument control, data interpretation and results processing.

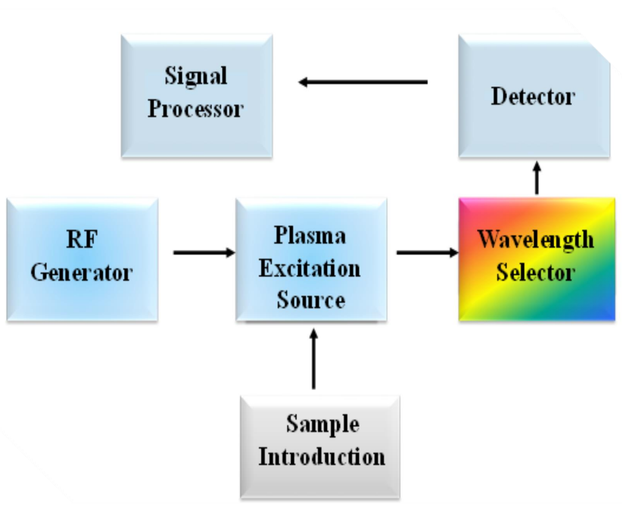

Figure 3: Main parts of the ICP-OES instrument

ICP-OES operates on the principle of light emission from the mineral elements present within the sample after they become energised by a plasma 'heat' source.

Each mineral element has a unique light or wavelength fingerprint, the intensity of which is equal to its concentration present in the sample.

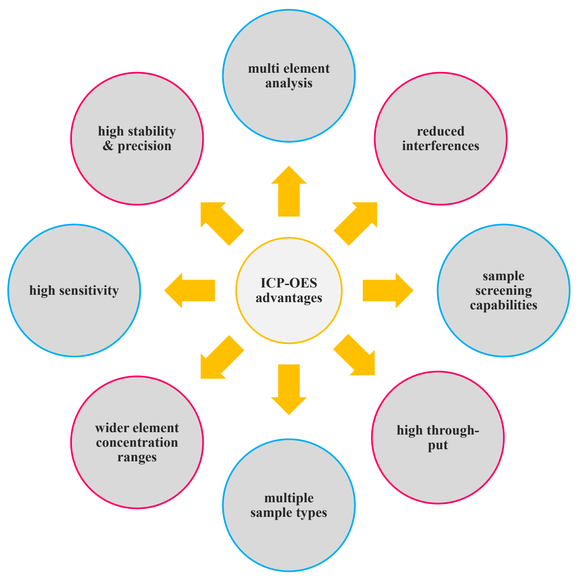

Figure 4: Advantages of ICP-OES over other analytical methods

Mineral elements	Biological presence	Conc. ranges investigated (mg/l)	Experimental wavelengths (nm)	Line type
Zinc (Zn)	Low	0.001 – 0.8 0.002 – 1.6 0.005 – 4.0	202.618 213.857	Hard
Iron (Fe)	Low	As per Zn	238.204 259.940	Hard
Magnesium (Mg)	High	As per Zn	279.553 280.270	Hard Soft
Phosphorus (P)	High	0.1 – 5.0 0.2 – 10 0.5 – 25	178.222 213.618	Hard
Potassium (K)	High	As per K	766.491 769.897	Soft
Calcium (Ca)	High	As per K	317.933 396.847 422.673	Soft
Sodium (Na)	High	10 – 60 20 – 120 50 – 300	588.995 589.592	Soft

Table 1: Mineral elements being investigated

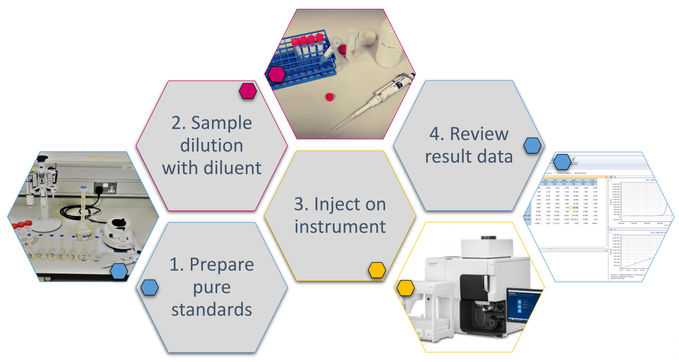

Figure 5: 'Dilute and Shoot' method flow

The analysis method being developed on the ICP-OES instrument is known as a 'Dilute & Shoot' method [3].

With this method a known volume of sample is diluted with a known volume of diluent and injected onto the instrument.

It is a simple approach requiring minimal sample handling and a short preparation time.

Findings

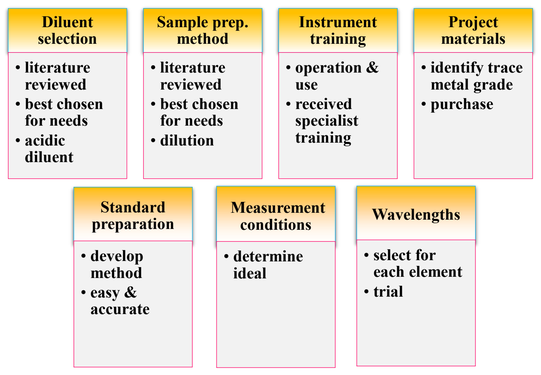

Figure 6: Activities completed on project

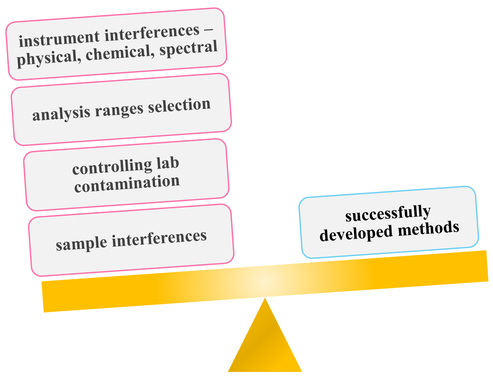

Figure 7: Future research challenges identified

This research is still in its early days, however from the activities achieved in Figure 6 and the main challenges identified in Figure 7, a clear path lies ahead for the development of these analytical methods.

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