

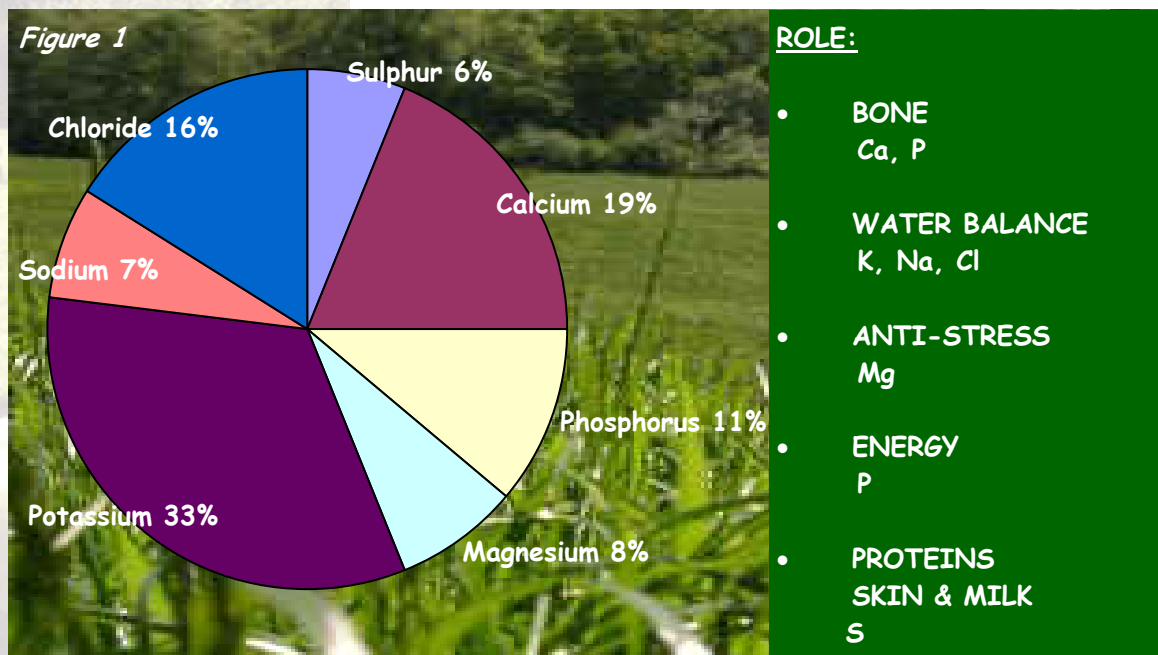
## The Mineral Specialists

### ESSENTIAL MINERALS FOR DAIRY COWS

Of the 92 elements naturally present in the earth's crust, there are 15 minerals which are recognised as being essential for animal life. These are divided into two groups dependent on the extent of their dietary requirement.

#### 7 Major (Macro) Minerals

The major, or macro, mineral group is composed of 7 elements, which for dairy cattle are shown in Figure 1. These are expressed in terms of their % dietary concentration. It is interesting to note

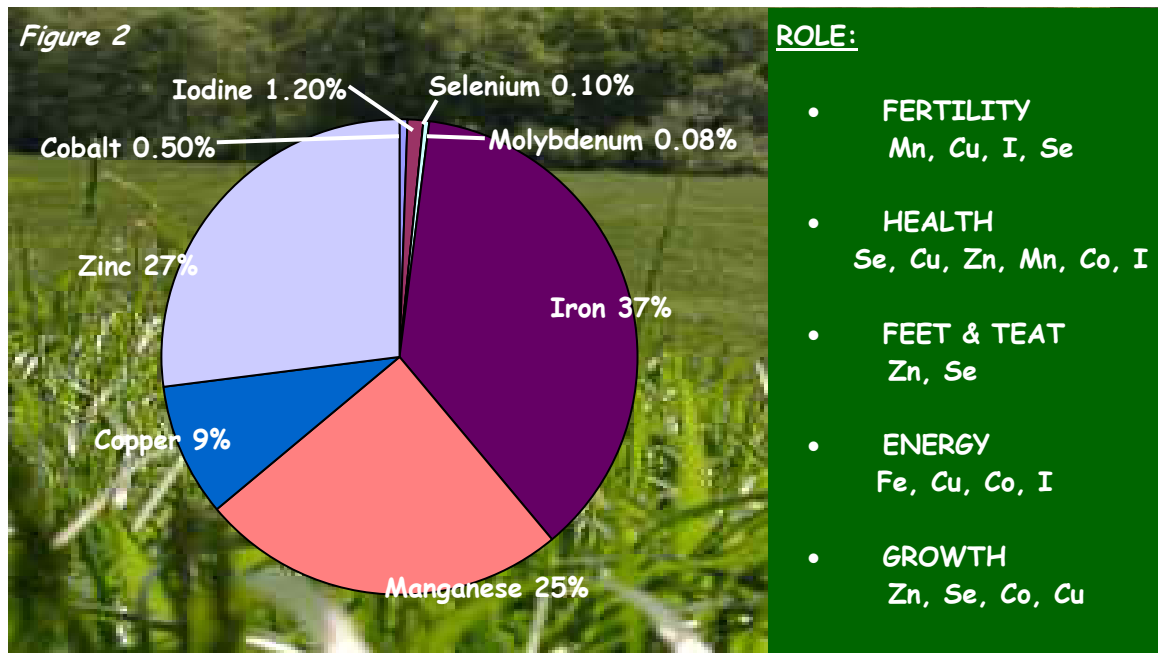


that 56% of the major mineral contribution of a dairy diet is made up from elements which control water balance (Potassium, Sodium and Chloride). As the control of water intake and excretion is fundamental to all life processes it is hardly surprising that the major part of mineral supply is associated with this function.

Of the remaining major minerals 30% (Calcium and Phosphorus) is related to skeletal development and bone mineralization, which again is a significant physiological activity. Minerals, of course, are multi-functional as shown by the key role of Phosphorus in energy utilisation, which is central to growth, milk production and fertility. The remaining major minerals are Magnesium (8%), which is essential for maintaining a healthy nervous system, and Sulphur (6%), a key component of the specialist proteins which make up surface tissues such as skin, hair, wool, feet and horn.

## 8 Trace (Micro) Minerals

Figure 2 presents the contribution of the 8 trace, or micro, mineral elements in a dairy diet. These are designated to this group because of their very low requirement, which is expressed in terms of



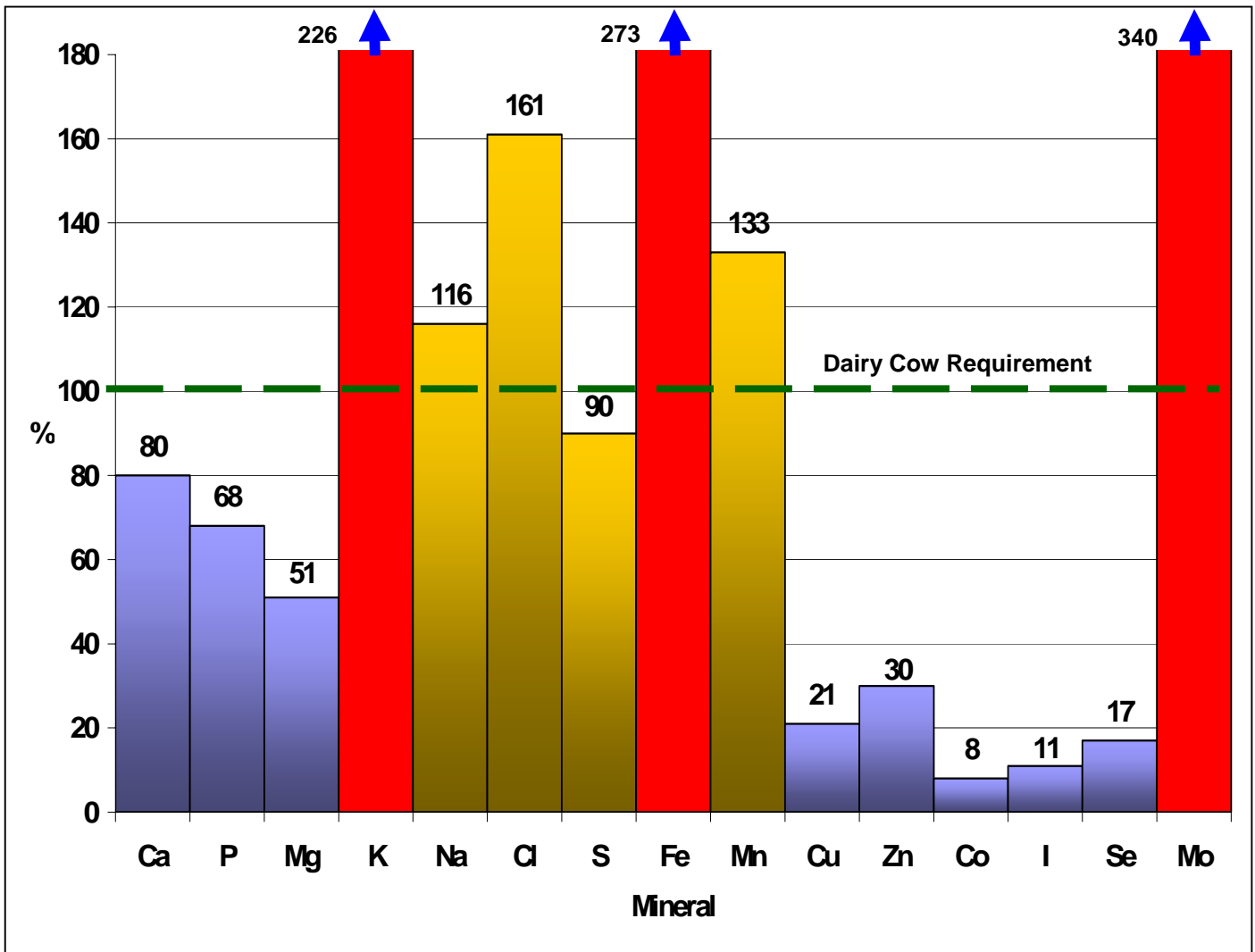
mg/kg concentrations. The trace element group is itself divided into two sections; with 98% being constituted of Iron, Zinc, Manganese and Copper, and the remaining 2% of Iodine, Cobalt, Molybdenum and Selenium. This quite striking division is undoubtedly related to the fact that while Iodine, Cobalt, Molybdenum and Selenium are essential for animals, they have no essential nutritional function in plants. This is in contrast to the larger group of Iron, Zinc, Manganese and Copper, which are necessary to sustain life in both animals and plants. However, their presence in either the larger or smaller trace element group seems to have no effect on the significance of their physiological role, as all trace elements are crucial to supporting health, growth, energy utilisation, fertility and the integrity of surface tissues such as skin, and the internal surfaces of the udder. While it is wrong to highlight any of the trace elements, it is a fact that in practice Copper, Zinc and Selenium provide the most problems with dietary supply, availability and imbalances with other elements.

## Grass Silage as a Source of Minerals

Having established the relative contribution of mineral elements in a dairy diet and their function, it is interesting to note the extent to which the mineral composition of the dominant forage (grass silage) meets the requirements of a moderately yielding dairy cow.

This is shown in Figure 3, with major minerals listed along the bottom left, followed by trace elements.

**Figure 3. Grass Silage as a Source of Minerals for Dairy Cattle**



This presentation shows a variable picture with both significant excesses and extreme deficiencies. However, the key concept of mineral balance is clearly illustrated, where the mineral composition of a plant (grass) bears no relationship to the animal (dairy cow) requirement. Undoubtedly in the distant past the mineral supply from grass and the needs of cattle were reasonably balanced. This is obviously not the case today, where improved breeding techniques have resulted in a separation of the cow from the forage it evolved on.

Macro minerals, Calcium, Phosphorus and Magnesium, although deficient, still manage to provide a useful contribution of between 50-80%. In contrast, Sodium, Chloride and Sulphur are either very close to, or slightly exceed, the cow's needs. However, the most striking feature of the macro mineral supply from average grass silage is the excess Potassium. For trace elements a variable pattern is again observed with Copper, Zinc, Cobalt, Iodine and Selenium reporting a very low supply relative to requirement, while Manganese is slightly above.

The dominant features are again the hugely excessive supply of Iron and Molybdenum. While identified deficiencies can be easily rectified by supplementation, the presence of excessive quantities of Potassium, Iron and Molybdenum result in significant mineral imbalances, with other related mineral elements, which if uncorrected have the potential to cause economically significant diseases (Table 1).

## Deficiency Diseases

Excess Mineral	Mineral at Risk	Deficiency Disease	Table 1
Potassium	Magnesium Calcium Sodium	Staggers. Extended calvings. Retained cleansings. Whites. Poor milk initiation. Oedema. Reduced DM intake.	
Iron	Copper Zinc Manganese Selenium	Silent heats. Poor bulling. Low conception rates. Reduced growth rates. Lameness. High cell counts. Poor health. Low conception rates. White muscle disease. Retained cleansings. Whites. Embryo loss. Depressed immunity.	
Molybdenum	Copper Selenium Vitamin E	Irregular oestrus cycling. Poor heats. Low conception rates. Oxidative stress. Reduced immune function. Poor health.	

Virtually all production diseases, including those occurring at calving (milk fever), at pasture (staggers) and infertility, can be traced back to excessive intakes of these 3 essential minerals—Potassium—Iron—Molybdenum—and a failure to neutralise their worst effects through balancing mineral nutrition.

### Summary

- Of 92 naturally occurring mineral elements, 15 are essential for animals.
- 7 Macro Minerals and 8 Trace Elements.
- Macro Minerals are mainly concerned with water balance (56%) and bone growth (30%).
- Trace Elements have multi-functional roles, but are important for supporting health, growth and production.
- Grass silage provides a variable mineral balance to dairy cow diets.
- Key feature of grass silage is the excessive supply of Potassium, Iron and Molybdenum.
- Excess intakes of Potassium, Iron and Molybdenum are implicated in a wide range of production diseases, including Milk Fever, Staggers, lameness, poor milk hygiene and infertility.
- Cost of production diseases is over £500 per cow in the average UK herd.

**Solution is to analyse forages for their mineral content and to develop a balancing mineral supplement, including Albion MAAC to ensure high mineral bioavailability.**

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