case hardening). It can also help determine whether the amounts of air recirculation are appropriate.

Look after humidity

In particular look out for "trying too hard" at the beginning of the drying process. Remember that too high a drying rate at the beginning – especially with air humidity too low – can be a major limitation through the "case hardening" effect.

Sometimes – as mentioned earlier – it can be appropriate to add steam in the early stage or stages (which not only adds humidity, but also supplies additional heat). But there are other ways of increasing humidity as well – for example increasing the percentage of air recirculation. Or taking air from later stages and using that air in earlier drying stages – counter-flow designs.

Optimise efficiency

Not just energy efficiency – in production environments production efficiency (related to throughput rate, which is limited by drying time) is very important. At the extremes, Production efficiency and energy efficiency can conflict – The highest possible energy efficiency could be achieved using the maximum possible humidity and minimum possible air flow – but production rate would be severely compromised.

But, understanding the "basics", for real processes the two can be complementary. That is, once we understand that maximum rate (throughput) is not achieved by using very low humidities and very high air flows, we can actually work on using higher – but appropriate - humidity at each stage, with sufficient - but not excessive - air flow, and achieve this by optimising air recirculation. And that way achieve the best balance for the process performance.

SUPPLEMENTING PET ANIMALS the efficient way!

By Mieke Zoon, Pancosma SA

We feed our pet animals more like humans than the animals they descend from. While the ancestors of our cats and dogs were mainly eating prey animals, nowadays a label of pet food looks more like a human dinner. How did that happen?

Firstly, most cats and dogs are raised in a limited living space, either completely indoors, or partly outside. Especially in densely populated areas they are kept with restricted freedom to move around the neighbourhood and surroundings. These restrictions are needed, because it is absolutely unacceptable for dogs to hunt down a neighbour's rabbit or chicken, or for cats to catch your daughter's hamster or beloved songbird! This limitation of natural behaviour and fulfilling nutritional requirements of the animal, gives pet owners a big responsibility to provide pet animals with a complete diet to support all body functions.

Secondly, not only are the animal's requirements important in pet food, but also the convenience for the owner is very important, if not sometimes even more important! This relates to the digestibility and therefore excretion by the animal, but also to the quality and conservation of the food, the smell and looks of it and of course the price.

With much known about feeding monogastric animals (poultry and swine) and more research being done on nutrition and requirements of pet animals, pet food producers try to optimize their formulations. To be able to optimize the price of pet food, many use meat based byproducts and vegetable sources as the main ingredients. These formulations then need to be supplemented to optimize nutrient availability to fulfill all nutrient requirements and improve palatability, conservation and appearance.

Mineral supplementation

For development, growth and maintaining health, mineral supplementation is essential in all phases of life. Compared to most monogastric livestock pet animals reach (much) higher ages, go through different phases of life and therefore also have different nutrient requirements. Finally, the huge variation in breeds and no selection on feed efficiency and growth performance traits, results in big variety between individual animals and breeds. Fulfilling nutrient requirements of pet animals in general and mineral requirements in particular is therefore challenging, but essential to maintain overall health and strength.

Essential minerals which are often supplemented are: zinc, copper, manganese and iron.

Zinc is a very essential mineral to maintain healthy skin, hair and nails. Next to that it is a critical element for many immunological processes to support general health and finally it is involved in the carbohydrate metabolism and reproduction.

Copper is involved in many processes in the body, with the main ones being the development of bone, connective tissue and collagen, the formation of hemoglobin and acting against free radicals in the body (anti-oxidant). It also aids the absorption of iron and the development of hair pigment.

Manganese is important for the proper function of many proteins and carbohydrates, fertility, growth and development, as it is necessary for the formation of bone and joint cartilage and neurological function.

Iron in combination with proteins and copper forms hemoglobin, essential for oxygen supply. Iron is needed continuously to provide

hemoglobin for newly produced red blood cells. Low levels of available iron will lead to the development of anemia.

In nature cats and dogs get the necessary minerals mainly by eating organ meat from prey animals. Mainly liver is rich in minerals as it is important for distribution and storage of many nutrients in all animals. However organ meat is not always available, allowed or consistent in quality for pet food producers to use as the main or only source of minerals in their feed.

Optimizing mineral supplementation

Absorption of minerals is limited because of antagonisms and interactions with feed components. Formation of insoluble, or too big to be absorbed, complexes with other components in the feed, limit availability of minerals for the animal. Next to that some minerals compete for the same transporters and metabolic processes for absorption, which limits the availability of these minerals or vitamins for the animal. Interactions between minerals (positive and negative for absorption) are always present and still new interactions are found, which indicates the complexity of meeting mineral requirements (figure 1). It is certain however, that simply increasing the supplementation levels is often not the solution to compensate for a low bioavailability.

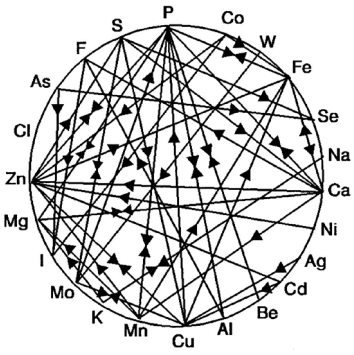


Figure 1. Mineral wheel with interactions, based on publications of Watts et al., 1988-1994.

Organic trace minerals

The negative effects of interaction with feed components and competition for absorption on bioavailability can be reduced by combining the mineral with an organic ligand. Inorganic mineral forms (mainly sulphates) are very weakly bound and are therefore free to interact. Organically bound (or chelated) minerals are not reactive,

Figure 2. The presence of zinc glycinate in water shown (using flight mass spectrometry), compared to the theoretical spectrum (Vacchina et al., 2010).

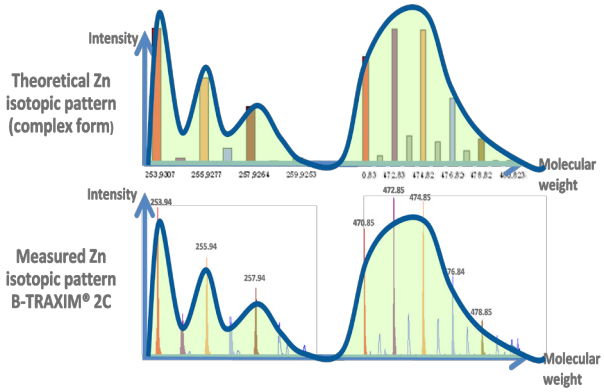


Figure 3. The recovery of B-TRAXIM® 2C products (Mn, Zn and Cu) as glycinates in different premixes

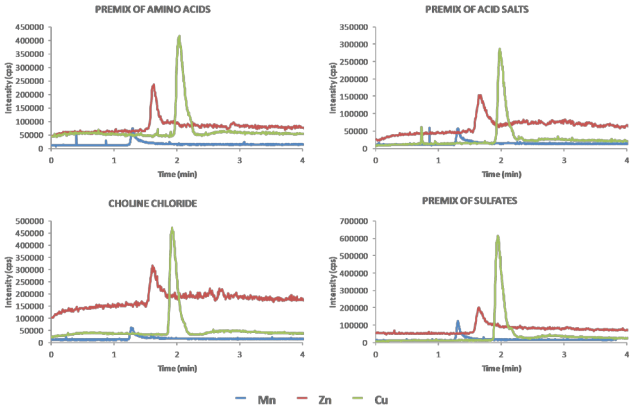
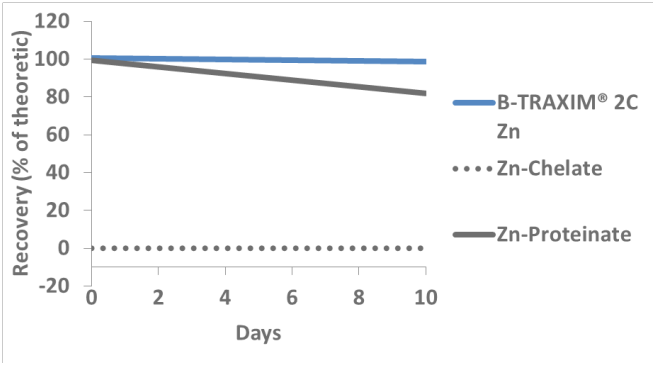


Figure 4. Stability of the organic bound mineral in acidic liquid feed



which will prevent interaction. Next to that competition for absorption can be avoided partly by absorption using the pathway(s) of the ligand.

Worldwide most organic trace minerals are bound to protein sources: hydrolyzed protein, non-specific amino acids, or specific amino acids.

Stability of the organic bond is essential to prevent interactions and competition and therefore the added value of an organic trace mineral (OTM). In different trials, the superior stability of a specific glycinate (minerals bound to the amino acid glycine), B-TRAXIM® 2C (Pancosma SA, Switzerland), has been shown in water (figure 2), at different pH, in premix (figure 3), in pelleted feed and even in the presence of known antagonists and in acidic liquid feed (figure 4).

B-TRAXIM® 2C products are produced using a unique spouted bed technology which is optimized to create superior handling and homogeneity of the products. A fine granulate without dust is the result (figure 5), perfect free-flowing, low risk for caking, due to less surface compared to finer products and improved distribution in premix

Figure 5. Left: B-TRAXIM® 2C Zn particles (microscopic), right: B-TRAXIM® 2C Cu (close up).

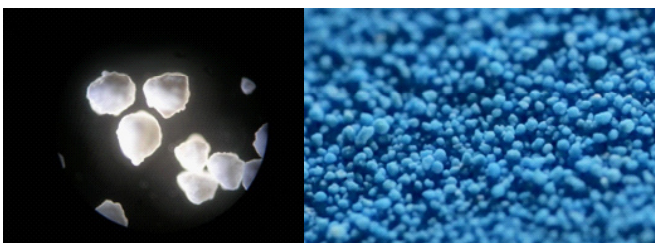
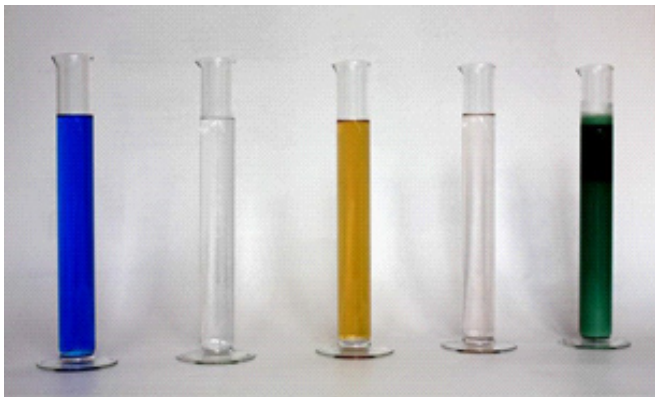


Figure 6. Perfect solubility of B-TRAXIM® 2C products compared to a main competitor (first from the right)



and feed, due to small and uniform particle size. As the ingredients are solubilized before spraying, the final products are perfectly water soluble (figure 6).

Glycine as ligand

Glycine is the smallest amino acid (figure 7), with good chelating properties (forming glycinates). It is also colourless, odourless and sweet-tasting, giving these properties also to the glycinates. It is used as an additive in pet food and animal feed as a taste enhancer. Because glycine has the lowest molecular weight of any amino acid, glycinates are very concentrated in mineral content and are more easy to be absorbed by the animal than larger mineral complexes.

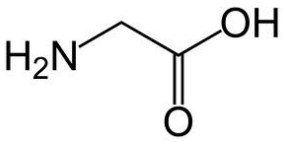
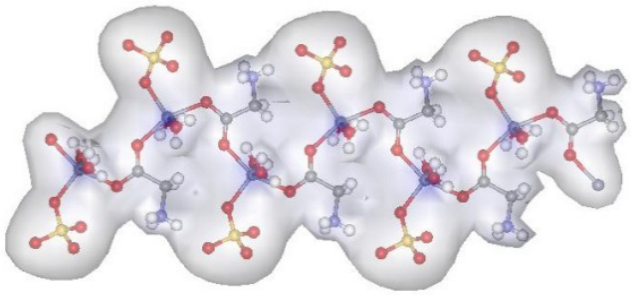


Figure 7. Chemical structure of the amino acid glycine.

Unlike some other producers of organic trace minerals the chemical structure and the stability in different environments have been clearly established. Oguey et al. (2008) established the chemical structure of the different crystalline complexes which give this range part of its name, 2C (figure 8).

Figure 8. The molecular structure of B-TRAXIM® 2C Cu or Zn.

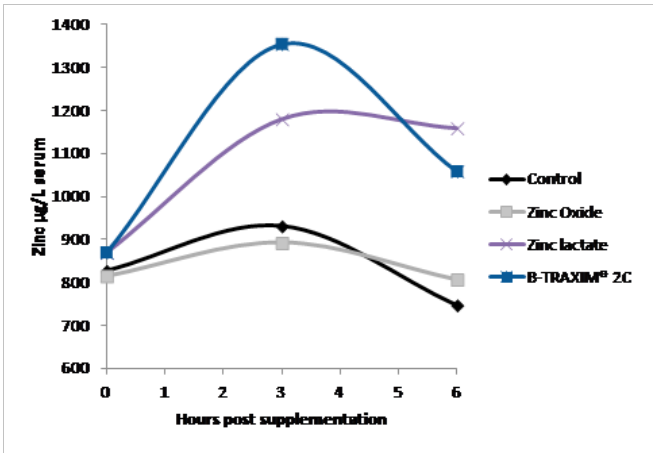


Available data in cats

Eleven European cats (4.6 ± 0.8 kg) were fed a single meal of either a control diet (un-supplemented), or a diet supplemented with a zinc source. The tested zinc sources were: zinc oxide, zinc lactate and B-TRAXIM® 2C Zn.

The zinc levels in the serum of the cats were measured every 2 hours during the first 12 hours post supplementation and after 24 hours, as an indicator of zinc bioavailability. The results obtained during the first 6 hours after supplementation were differentiating (figure 9).

Figure 9. Zinc serum level over the first 6 hours after supplementation.



These results highlight that organic sources are able to increase overall zinc level in the serum of cats during the first hours after supplementation. It confirms the results already obtained in other animal species (swine, poultry and ruminants). In addition, zinc oxide which is known to have a low bioavailability in several animal species did not modify this parameter, as zinc serum levels measured were similar to the one of the un-supplemented control group. Numerically, B-TRAXIM® 2C intake induced a higher maximum level of zinc in the serum of cats than all other sources tested, showing its higher bioavailability.

Conclusion

Pet animals are very diverse in their nutrient requirements, depending on breed and phase of life mainly. Minerals are not only essential for growth and development, but also for overall maintenance and health of pet animals. Efficient supplementation of minerals is needed to meet requirements. Over-supplementing is often not the answer, because of mineral interactions, like competition for absorption. B-TRAXIM® 2C products are an OTM source with proven efficacy in livestock, which have also shown to increase mineral levels in the serum of cats. This is a good indication for higher bioavailability of this mineral source and therefore makes it interesting to optimize mineral supplementation in pet food.

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