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Calf Note #159 – Caring for your functional products

Introduction

Functional products are the latest wave of technology in animal and human nutrition and health. There are many kinds of "functional" products, which are sometimes referred to a "functional foods", "nutraceuticals", and other terms. Essentially, a functional product is one that *does something* above and beyond the nutrients inherent in the product. Some examples of functional products include probiotics and enzymes. Probiotics (also called direct fed microbials or DFM's) were evaluated in Calf Note #157. Dietary enzymes are widely used in poultry diets and many other applications though they're not widely used in ruminant diets.

Functional proteins are a class of functional products that contain a known amount of a protein (such as an enzyme or immunoglobulin) that exerts an effect on the animal, usually in the intestine. Functional proteins are commonly included in calf milk replacers and are essential components of colostrum supplements and colostrum replacers. An article on the use of functional proteins is available here. There are functional fats and functional carbohydrates, as well.

Each of these functional ingredients does something in the animal. For microbial products, the bacteria or yeast cells must be alive to exert their influence. Other functional ingredients require a specific molecular conformation for the ingredient to be functional. So, if we expect these products to work the way they're intended, we have to care for them appropriately.

Caring for functional products

There are several conditions that destroy functionality of most products, including heat, oxygen, light and moisture. Let's look at how each influences functionality of ingredients.

Heat. Heat is the "universal killer" of functional ingredients. Exposing products containing functional ingredients to elevated temperatures will almost always reduce or eliminate the effectiveness of the ingredient. In some cases, heating a functional product may actually reduce the value of other nutrients.

To understand the effects of heat on functional products, let's consider an example of a calf milk replacer containing added IgG. The IgG are added to the CMR to provide additional immune support to the calf during the all important first three weeks of life.

IgG molecules (like all functional proteins) has a special three dimensional structure. This structure gives each protein its unique appearance and its biological activity. The IgG molecule looks like the letter "Y" and each part has a unique and important function. This structure is held together by

special bonds called disulfide bonds. Disulfide bonds are less strong than the bonds that hold individual amino acids together in the basic structure of the protein.

When a protein is heated, the internal "activity" of the protein increases. This means that the various bonds, linkages and bridges that hold the three dimensional structure together may become "loose" and if the activity increases to some critical level, the structure may fall apart. Usually, this change in structure is permanent and the protein no longer works the way it is supposed to. In the case of the IgG molecule, heating to temperatures >60°C (145°F) will cause the proteins to change conformation and functionality will be lost.

Functional ingredients should generally be stored at room temperature (i.e., 20-25°C or 68-75°F). Read the label carefully – it should have specific instructions on how to store the product. Generally speaking, the hotter the storage conditions, the more likely that functionality will be lost. Cold storage is generally good for functional ingredients and stability of most functional ingredients can be extended if the product are stored cold.

Oxygen. If heat is the "universal killer" of functional ingredients, then oxygen is the willing accomplice. Oxygen is an oxidizing agent (for more information on the chemical process of oxidation, see the Wiki article on Redox). Oxygen contributes electrons to many molecules, including proteins and fats. These electrons quickly cause the breakdown of the molecule and loss of functionality.

Eliminating oxygen from the storage environment is essential for most functional ingredients. That's why most products on the farm containing functional ingredients (e.g., colostrum supplements) are packaged in a heat sealed pouch. It's important that these products be kept away from oxygen for as long as possible. Once the package is opened and oxygen enters, the amount of oxidation will increase exponentially. Controlling oxidation requires reducing amount of electron donors (e.g., oxygen), keeping the product dry and cool. Products stored in a plastic bag should be tightly re-sealed to reduce the infiltration of oxygen.

A method to control oxidation in feeds (whether or not they contain functional ingredients) is to add antioxidants. These molecules protect other ingredients from oxidation. A number of antioxidants are used in animal feed to minimize the effect of oxygen and other oxidizing agents on the product. A long Wiki article on antioxidants is here.

Light. The presence of UV light can catalyze oxidation in many animal feeds and ingredients. When these ingredients are exposed, the oxidation process is hastened, and loss of quality occurs. Most functional ingredients and products are stored in sealed paper or plastic bags to eliminate both oxygen and light from entering the product.

Moisture. The effect of moisture on stability of functional ingredients is related to microbial stability rather than oxidation. When products are dried, the amount of water is too low in the product and microbes (yeast, bacteria) can't grow. This effectively stabilizes the product. However, when a sealed container of product is opened and air enters, the moisture in the product will quickly

equilibrate with the moisture in the air. If the amount of moisture in the air is high enough, it may allow microbes in the product to grow, thereby spoiling the product.

Repeated exposure to changing humidity can cause condensation, which provides plenty of moisture for microbial growth. Condensation is a common cause of product spoilage in the field. Producers should carefully seal unused product so that air (and humidity) cannot repeatedly move into and out of a product. This will lengthen the shelf life of the product.

Summary

General recommendation for any and all functional ingredients are to keep them (1) cool (room temperature) (2) dry, (3) in a sealed container, and (4) away from direct sunlight. Managing these products in this way will enhance their shelf-life and allow the producer to see the responses in the animals fed these products.