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RECENT ADVANCES IN POULTRY NUTRITION

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Poultry nutrition has attracted much attention and development over the last few years. The research in this field has mainly focused on use of biotechnological products (additives), the nature and treatment of raw materials, feeding systems and the effect of heat stress.

Rearing poultry in tropical and semi-tropical conditions involves adapting nutritional and housing systems. Many results obtained in European countries may be applied in Africa, especially those related to the improvement of the nutritional value of raw materials and to methods of feeding birds under hot conditions.

In this paper, studies carried out in my laboratory are briefly presented and data concerning new additives, form of feeds, self selection and heat stress are discussed.

NEW ADDITIVES

Recently many countries banned using antibiotics as growth promoters for poultry. As alternatives, the development of probiotics has been pursued in order to protect animals against pathogens, and enzymes that improve the nutritional quality of feedstuffs have been studied.

PROBIOTICS

Probiotics are micro-organisms capable of colonising the alimentary canal. For ruminants, both yeasts and bacteria have been tried, but only bacteria have been proposed as additives in poultry feeds. The mechanisms of action have not yet been identified, while the effects on the animals' performances are variable and are largely dependent on the age of the animals, on the feed composition and on the rearing conditions. The greatest effects are observed when the animals are young and the farming conditions are mediocre.

A micro-organism which is added to feed can colonise the digestive tract, modify the pH of the intestinal contents and favour the development of lactobacilli at the expense of colibacilli. This results in decreased mortality, an increase in growth rate and a reduction in the feed conversion ratio.

In addition to probiotics, several compounds, which are generally acidifying agents, have been approved as feed additives. These compounds alter the physico-chemical environment of the digestive tract and reduce the development of anaerobic flora. This can result in improved growth performance and a decrease in the level of mortality.

So far, scientific research has been unable to elucidate the mechanisms by which both probiotics and acidifying agents act , thus it has not been possible to devise practical rules for their use.

ENZYMES

The formulation of animal diets is quite variable and is dependent on the cost of the ingredients which in turn depends on their availability. The use of rye and bailey in poultry diets is relatively common in northern and eastern Europe, while wheat is used in all European countries. This is because of their low price compared to that of corn.

Low digestibility of nutrients and litter problems are observed when feeding these cereals. The detrimental effects, identified three decades ago, are related to the non-starch polysaccharide (NSP) composition of these grains (1). Eliminating these anti-nutritive components increases the productivity of the diet and in doing so, reduces manure output. Successful enzymatic degradation of NSPs not only requires an understanding of the structure but also a knowledge of how NSPs interfere with digestion and absorption.

The bulk of the NSP encrusting the endosperm cell wall is composed of arabinoxylan. This is constructed of D-xylose linked ß, 1-4 to arabinose substituted along the backbone. If arabinose was absent, the xylan polymer would be able to interact with other xylan molecules and precipitate. The presence of arabinose renders this polymer soluble. Mixed linkage ß-glucans comprise the bulk of the NSP in oat and barley endosperm cell walls. These molecules (arabinoxylans and ß glucans) cause problems due to viscosity in the intestine.

In our laboratory, the mode of action of soluble NSPs has been studied. One practical way of overcoming the problems associated with NSPs is the use of exogenous enzymes (2). These enzymes are derived from two main sources, fungi and bacteria. They vary widely in their characteristics - molecular weight, optimum tepmperature and pH, V_{max} and K_m (3). Feeding diets rich arabinoxylans and ß-glucans to young poultry has long been known to be fraught with problems. Growth rate and feed

conversion ratio are significantly depressed as the concentration of these grains increases whilst the moisture content of the litter is elevated. Beta glucans and arabinoxylans exert their negative effects by an elevation of viscosity of the contents of the small intestine. Such an elevation results in a reduction in the rate of digestion and absorption of nutrients, an elevation of microbial activity in the intestine, a reduction in feed intake and increased litter moisture. In growing broilers, both the growth rate and feed efficiency are reduced (2), while in laying hens, both the laying rate and the mean egge wight are diminished (4, 5)

The utilisation of xylanase and ß-gluconase can alleviate these problems by reducing the molecular size of the target substrate, which in turn reduces the viscosity of the intestine and hence enables more rapid digestion :

- Apparent digestibility of amino acids in improved by 10 to 15 % with enzyme supplementation.
- Wet faecal production is reduced by more the 25 %.
- The enzyme not only improves the digestibility of the cereal grain which is the source of the anti-nutrient but also the digestibility of the other dietary components.

The use of exogenous enzymes as a cost-effective means of improving the digestibility of wheat and barley and the subsequent performances of poultry is already relatively commonplace. To increase the availability of phosphorus in grains (including soybean), commercial products containing phytase activity are as well as xylanase and ß glucanase activities are used in many European countries. This renders organic phosphorus digestible thereby reducing environmental pollution by this element.

FEEDING SYSTEM AND FORM OF FEEDS

Instead of using complete diets in mash or in pellet form, many studies have been conducted on choice feeding at different ages and the adaptation of birds to such regimens under tropical climates. Grinding of grains was also shown to have an important effect on the physiology of the digestive tract and on growth performances.

Heat is a major constraint for poultry farming in tropical zones. It causes a decreased rate of growth in broilers which is the result of a severe depression in food intake. There is also a direct effect of temperature on the animal's physiology. Several nutritional strategies have been devised to improve food consumption:

- increase the protein content of feed
- replace a proportion of carbohydrates by fat to diminish diet-associated thermogenesis

Neither strategy has produced convincing results. Instead of modifying feed composition, several authors have tried offering a free choice of the various dietary components. This gives the animal the chance to modify its ingestion of protein and energy but has not produced results which are dependent on the temperature, which is what is sought for hot climates. Joint studies by France and the Ivory Coast have involved the use of whole cereal grains in a separate feeding system at two different times of year when the temperature varies from a minimum of 22-25°C to a maximum of 29-35°C (6).

Free choice feeding including whole grains (cereals) and a complementary concentrate, was compared to a complete ground or pelleted feed to study the ability of broilers to adjust their energy and protein intake to their needs.

Whatever the season, free choice fed broilers weighed 4-7 % more than the complete feed ground fed broilers.

A week of adaptation to free choice feeding was necessary. With this technique, the direct use of grain (corn or millet) is possible without transportation, grinding, mixing and pelleting.

Similar studies have been carried out on laying hens. Results obtained showed that the free choice feeding with a restriction on the complementary feed led to better performances than the classical feeding system (complete mash feed).

HEAT STRESS

Losses due to heat stress can be limited by adjustment of the housing conditions, by husbandry management of the chickens and by practices that enhance the adaptability of broilers to heat stress conditions such as early-age thermal conditioning (7, 8, 9). In our laboratory the effects of early-age thermal conditioning and dual feeding on responses of male broilers to a thermal challenge at 34 d of age have been studied (10).

Growth and feed efficiency were slightly enhanced by thermal conditioning and slightly reduced by dual feeding. Mortality during the thermal challenge was reduced by both factors.

It was concluded that thermal conditioning at 5 days of age induces a consistent metabolic change in broilers with dual feeding inducing transitory effects on heat production during heat stress.

CONCLUSION

The examples given here of work that is in progress illustrate the importance of nutrition. Within Europe, feed given to poultry has to satisfy food safety regulations pertaining to animals and to man. Examples are the prohibition of antibiotics to avoid the development of resistant strains in man, or the use of probiotics and enzymes to protect animals against a pathogenic flora.

In hot countries, a nutitional strategy is necessary to reduce the adverse effects of heat, thereby decreasing mortality and increasing growth performance.

REFERENCES

Arjona, A. Denbow D., Weaver W., 1988. Effect of heat stress early in life on mortality of broilers exposed to high environmental temperatures just prior to marketing. Poultry Sci. 67:226-231.

Bedford M.R., Schulze H., 1998. Exogenous enzymes for pigs and poultry. Nutrition Research Reviews. 11:91-114.

Chesson A., 1993. Feed enzymes. Animal Feed Science and Technology.45:65-79.

De Basilio V., Vilarino M., Yahav S., Picard M., 2000. Early age thermal conditioning and a dual feeding program for male broilers challenged by heat stress. Poult. Sci. (in press).

Jaroni D., Scheideler S.E., Beck M., Wyatt.C., 1999. The effect of dietary wheat middlings and enzyme supplementation. Late egg production efficiency, egg yields and egg composition in two strains of Leghorns hens. Poult. Sci. 78:841-847.

Sunna A., G. Antranikian G., 1997. Xylanolytic enzymes from fungi and bacteria. Critical Reviews in Biotechnology. 17:39-67.

Wyatt C.L., Goodman T., 1993. Utilisation of feed enzymes in laying hen rations. J. Appl. Poultry Res. 2:68-74.

Yahav S., Plavnik I., 1999. Effect of early age thermal conditioning and food restriction on performance and thermotolerance of male broiler chickens. Bri. Poult. Sci. 40:120-126.

Yo T., Picard M., Guerin H., Dauvilliers P., 1994. Alimentation séparée (céréales graines entières + aliment complémentaire granulé) chez les poulets de chair en climat chaud. Revue Elev. Med. Vet. Pays Trop. 47(3):319-327.

Zhou W., Fujita M., Ito T., Yamamoto S., 1997. Effects of early heat exposure on thermoregulatory responses and blood viscosity of broilers prior to marketing. Br. Poult. Sci. 38:301-306.