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KEMZYME MAP DRY IMPROVES NUTRIENT UTILIZATION OF BROILER DIETS – A CHALLENGE STUDY

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Abstract

Following the increase in maize and soya prices, great potential is seen for the use of alternate feed ingredients in poultry diets. KEMZYME MAP Dry is a multi-enzyme product containing NSP hydrolyzing enzymes, multi-amylases and multi-proteases, developed to maximize nutrient digestibility of broiler diets. The *in vivo* effect of KEMZYME MAP in improving growth performance of broilers was evaluated in growth trial. Treatments used for the growth trial were (1) Positive control diet (corn-soybean), (2) Negative control diet (energy reduced by 100 kcal/kg and crude protein reduced by 2.5%) and (3) Negative control diet + KEMZYME MAP Dry (500 g/t). Results of the performance trial showed KEMZYME MAP Dry significantly improved feed conversion ratio (3.7 points, $P<0.05$) over negative control diet. These results clearly demonstrated the potential of KEMZYME MAP Dry in improving the nutrient quality of low cost diets containing alternate feed ingredients thus resulting in significant savings in feed cost without compromising broiler performance

Key words: KEMZYME MAP, multi-enzyme, broilers, energy, protein sparing, alternative feed ingredients

Introduction

With the rise in maize and soya prices worldwide, a great potential is being seen for using more alternative feed ingredients in broiler diets. However, most of these non-conventional feed ingredients contain non-starch polysaccharides (NSPs) which possess anti-nutritional properties resulting in a decrease in the metabolizable energy of diets with a concurrent increase of the feed conversion ratio. Enzyme supplementation helps to upgrade the nutritive value of alternate feed ingredients, thereby providing economic benefits as well as increased flexibility in the choice of feed raw materials to the customer. NSP enzymes facilitate the digestion of NSPs. Research has shown that the starch digestibility is incomplete even in fully grown broilers[1]. Starch digestibility could be maximized using a combination of exogenous amylases which could synergistically act on different types of glycosidic bonds (Figure 1)[2].

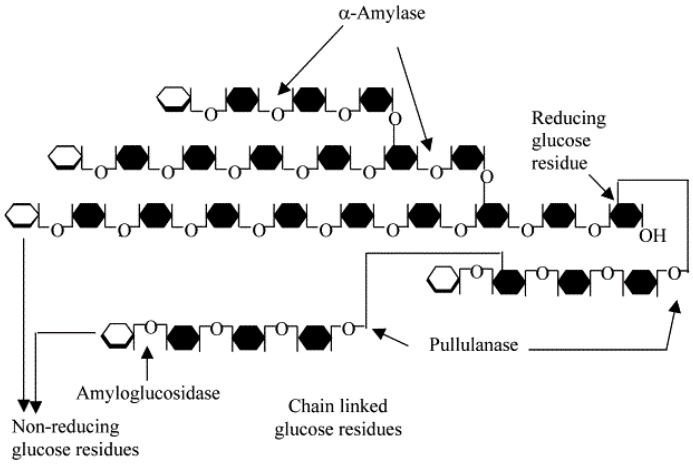

Figure 1. Action of different types of amylolytic enzymes on starch[3]

Currently, protein has become one of the more costly components in broiler diets and hence research has focused in the direction of improving protein digestibility. Proteases play a vital role in animal performance, as they breakdown protein into amino acids which are utilized by broilers. Research has found that the digestion of proteins and absorption of amino acids is the most limiting of the nutrients in young broilers[1,4]. Proteolysis begins in the stomach under the action of pepsin at acidic pH and proceeds in the intestine at a more neutral pH due to the action of pancreatic proteases. Moreover, crude protein and amino acid digestibility reported for poultry indicate that valuable amounts of protein pass through the GIT without being completely digested[5-7]. This undigested protein represents an opportunity for the use of supplemental exogenous proteases in broiler feeds to improve protein digestibility.

When considering protein digestion by broilers, it is of interest to identify the limiting factors. Protein digestion in birds starts in the proventriculus and the gizzard by the action of hydrochloric acid and pepsin, and involves denaturation of protein together with the activation of the protease, pepsin. Research data indicate that the production and secretion of gastric acid by the proventriculus of the broiler chicken is limited at a very young age. Low levels of gastric acid could compromise the first steps of protein digestion; denaturation of proteins and conversion of pepsinogen to pepsin, the first enzyme responsible for protein digestion. During the first 15 days of age, the pH of the gastrointestinal tract changes significantly and these changes may also have a significant impact on protein digestion and other digestive traits in young broilers[8].

Hence reduced protein digestion in broilers may be the result of reduced gastric acid secretions, inadequate secretion of proteolytic enzymes and the significant changes in pH conditions which are not conducive for optimum protease activity. The use of a multi-protease system designed to sustain protease activity under fluctuating pH conditions inside the GI tract will further enhance the digestibility of protein sources and provide economic benefits (Figure 2)[9]

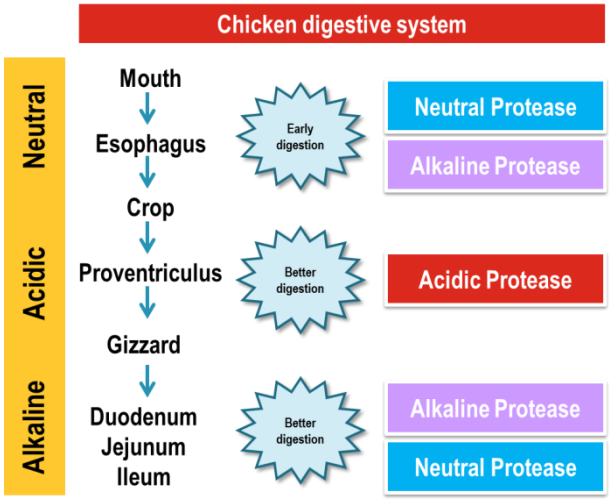

Figure 2. Schematic representation of the action of multi-proteases in poultry GI tract

Kemin Animal Nutrition and Health, Asia Pacific, has developed a unique combination of different proteases (acid protease, alkaline protease and neutral proteases) which showed superior *in vitro* and *in vivo* efficiency in improving protein digestibility compared to a single neutral protease[9,10]. A combination of NSP enzymes, amylases and proteases working together to digest the poorly digestible segments of feed ingredients could increase the energy and amino acids available for growth.

This paper explains the results of challenge growth study conducted to evaluate the efficacy of KEMZYME MAP, a multi-enzyme product containing NSP enzymes, multi-amylases and multi-proteases in improving growth performance of broilers.

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Materials and Methods

The growth trial was conducted at Bangkok Animal Research Center (Thailand). Treatments used for the growth trial are shown in Table 1. Composition of the diets used for the growth trial is given in Table 2. Newly hatched male broiler chicks (Arbor Acres Plus) were randomly allocated to 3 treatments with 8 replications in a randomized complete block design experiment, using 10 chicks per pen. Feeds in mash form were fed to birds and water and feed were provided for ad libitum intake. Feed intake, body weight gain, feed conversion and mortality were determined and subjected to analysis of variance as a randomized complete block design. Data was analyzed using Stratgraphics.

Table 1. Treatments used for the growth trial.

Treatments	Diet	Details	Enzyme &Dosage (g/t)
T1	Positive control	-	Nil
T2	Negative control	Energy reduced by 100kcal/kg, 2.5% of Total Crude Protein reduced	Nil
T3	Negative control + KEMZYME MAP	Energy reduced by 100kcal/kg, 2.5% of Total Crude Protein reduced	500 g/t

Table 2. Composition of diets

Ingredient	**Starter (0-21 days)**		**Grower (21-35 days)**		**Finisher (35-42 days)**	
	Positive control (%)	Negative control (%)	Positive control (%)	Negative control (%)	Positive control (%)	Negative control (%)
Corn	50.47	32.54	55.82	31.82	58.47	32.09
Soybean meal	23.43	19.78	17.15	10.35	14.71	5.00
Full fat soybean	15.00	12.66	15.00	15.92	15.00	18.22
Fish meal	3.00	3.00	3.00	3.00	2.00	2.00
Cassava		12.00		15.00		15.00
Rice bran (defatted)		5.00		6.00		7.00
DDGS 27%		4.00		5.00		6.00
Canola meal		3.00		4.00		5.00
Crude Palm oil	3.74	3.74	5.35	5.35	5.99	5.99
MDCP	1.47	1.46	1.33	1.28	1.36	1.27
Limestone 39% Ca	1.29	1.20	1.14	1.03	1.12	1.00
Salt	0.27	0.24	0.22	0.18	0.20	0.15
DL-Methionine	0.28	0.27	0.16	0.15	0.20	0.19
L-Lysine HCl	0.15	0.20	0.01	0.08	0.07	0.17
L-Threonine	0.07	0.09		0.01	0.04	0.06
L-Tryptophan	0.03	0.02	0.02	0.03	0.04	0.06
Sodium bicarbonate	0.15	0.15	0.15	0.15	0.15	0.15
Choline chloride 60	0.05	0.05	0.05	0.05	0.05	0.05
Vitamin/Minerals premix	0.20	0.20	0.20	0.20	0.20	0.20
Pellet binder	0.30	0.30	0.30	0.30	0.30	0.30
Toxin binder	0.05	0.05	0.05	0.05	0.05	0.05
Coccidiostat	0.05	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00

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Calculated analysis						
ME (Kcal/kg)	3000	2900	3125	3025	3175	3075
Crude protein (%)	23.00	22.43	20.00	19.50	18.50	18.04
Dry matter (%)	87.91	88.44	87.98	88.69	87.99	88.84
Crude fiber (%)	3.14	4.06	2.95	4.16	2.88	4.28
Dig.Lys (%)	1.24	1.21	0.97	0.95	0.92	0.90
Dig.Met (%)	0.61	0.58	0.46	0.43	0.48	0.44
Dig.Cys (%)	0.31	0.28	0.28	0.24	0.27	0.23
Dig.Met+Cys (%)	0.92	0.90	0.74	0.72	0.74	0.73
Dig.Thr (%)	0.81	0.79	0.65	0.63	0.64	0.62
Dig.Trp(%)	0.20	0.19	0.16	0.16	0.16	0.15
Dig.Arg (%)	1.38	1.31	1.19	1.10	1.08	0.99
Dig.Val (%)	0.94	0.91	0.83	0.79	0.76	0.72
Dig.Ile(%)	0.81	0.77	0.71	0.67	0.66	0.61
Dig.Leu(%)	1.68	1.56	1.52	1.37	1.43	1.27
Calcium(%)	1.00	1.00	0.90	0.90	0.85	0.85
Total Phosphorus(%)	0.74	0.82	0.69	0.79	0.66	0.78
A. Phosphorus(%)	0.45	0.45	0.42	0.42	0.40	0.40
Potassium(%)	0.93	0.91	0.82	0.80	0.77	0.73
Sodium(%)	0.20	0.20	0.18	0.18	0.16	0.16
Salt(%)	0.38	0.37	0.33	0.31	0.29	0.26

Results and discussion

As evident from the results, the inclusion of alternate feed raw materials produced a negative impact on broiler growth performance (Table 3).

Table 3. Effect of KEMZYME MAP broiler growth performance[11].

	Positive control	Negative control	Negative control + KEMZYME MAP
Body weight (g/bird)	2930 [a]	2681 [a]	2800 [a]
Feed intake (g/bird)	5002 [a]	4933 [a]	5048 [a]
FCR	1.707 [a]	1.840 [c]	1.803 [b]

[a, b,] Means with different superscripts are significantly different ($P < 0.05$).

Birds fed negative control diet with lower energy and Crude Protein content showed a reduction in body weight of 248g and increase in FCR by 13.3 points compared to those fed positive control diets (P<0.05). Inclusion of alternative feed raw materials in broiler diets could result in reduction in nutrient utilization owing to the presence of anti-nutritional factors, which increases digesta viscosity which in turn decreases the activities of digestive enzymes and minimizes the diffusion capacity of nutrients across a thicker, unstirred water layer of the intestinal brush border. Feeding NSP-rich diets to broilers has been reported to create a marked effect on villus length (shorter), width (narrower), and surface (reduced), which significantly reduces the absorptive capacity for nutrients. Other unwanted effects being the increase in stress related problems and induction of gas production from abnormal fermentation by microorganisms in the hind gut. All these factors contribute to reduced growth performance and economic returns.

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Enzyme addition to negative control diets improved the body weight by 119 g and FCR by 3.7 points (P<0.05) (Table 3). Supplementation of KEMZYME MAP thus improved body weight and feed conversion ratio by 4.5% and 2%, respectively.

In this study, digestibility of NSPs, starch and proteins were maximized through the use of an optimum combination of NSP enzymes, multi-amylases, and multi-proteases. Results from our studies clearly indicate the negative effect of using alternative feed ingredients on the metabolizable energy and growth performance of broilers and the ameliorating effect of the right combination of enzymes in improving the nutritional quality of such diets. The beneficial effect of KEMZYME MAP supplementation may be attributed to a combination of different factors such as (1) the elimination of the nutrient encapsulating effect of the cell walls thereby improving energy and amino acid availability, (2) solubilization of cell wall, NSPs for more effective hindgut fermentation and improved overall energy utilization, (3) maximizing digestibility of protein by maintaining protease action throughout the GI tract and (4) hydrolysis of different types of amylolytic linkages in starch thus maximizing digestibility and (4) elimination of the anti-nutritive properties of dietary components, including NSP, by their enzymatic hydrolysis to the prebiotic type components which, in turn, may facilitate gut development and health in chicken.

The result of the present study suggests that the addition of KEMZYME MAP to low-nutrient-density diets has the potential to partially replace energy-yielding and protein feedstuffs for broilers thus resulting in significant savings in feed cost without compromising animal performance.

Return on investment (ROI) for KEMZYME MAP: KEMZYME MAP supplementation to low energy, lost cost diets could effectively improve broiler growth performance which leads to a net return of USD 8.5/ton of feed and a corresponding ROI of 1:3 (Table 4). For every 10,000 ton of feed, use of KEMZYME MAP at 500g/t gives a profit of 1 million USD/annum.

Table 4. Value added calculator for KEMZYME MAP supplementation based on growth performance

	Positive Control	Negative Control	Treatment
Broiler PERFORMANCES			
LIVABILITY (%)	100.0	100.0	100.0
MORTALITY (%)	0.00	0.00	0.00
FINAL WEIGHT (g)	2930	2681	2800
FINAL WEIGHT (kg)	2.93	2.68	2.80
F.C.R.	1.707	1.840	1.803
FEED CONSUMED per BIRD (Kg)	5.00	4.93	5.05
COST OF Animal PRODUCTION			
Live weight (Kg) per kg of feed	0.59	0.54	0.55
Live weight (kg) per ton of feed	585.82	543.48	554.63
Feed cost per kg live wt (USD)	0.28	0.25	0.25
REVENUES			
REVENUE from live weight for every ton of feed (USD)	761.57	706.52	721.02
Gross Income (USD/ton of feed)	275.54	251.60	263.10
Relative %	100.00	91.31	95.49
Gross Returns from KEMZYME MAP (USD/ton)			11.50
Investment for KEMZYME MAP (USD/Ton of feed)			3.00
Net return from KEMZYME MAP (USD/ton)			8.50
Return On Investment			**3.83**

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Conclusion

The aim of the present study was to evaluate the effect of KEMZYME MAP, a multi-enzyme product containing NSP hydrolyzing enzymes, multi-amylases and multi-proteases, on the production performance of low energy & crude protein diet of broiler birds. Significant drop in performance of negative control diet was observed due to reduction in metabolizable energy and crude protein levels in the diets. The result of the present study suggests that the addition of KEMZYME MAP to low-nutrient-density diets has the potential to partially replace energy-yielding and protein feedstuffs for broilers thus resulting in significant savings in feed cost without compromising animal performance.

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