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IMPACT OF ENZYME PRE-TREATMENT OF EXTRUDED SOYBEAN ON PERFORMANCE OF MALE BROILER CHICKENS

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Abstract: **The increased meat demand is a driver of poultry production which is expected to make up 39% protein source by 2030. This is because of its nutritional value, and also because there are no religious or cultural barriers hindering the production and consumption. The banning of animal products as a source of protein in the nutrition of animals in the EU, necessitates an alternative protein source. Soybean is considered as a source of plant protein in sustainable poultry production because it is relatively cheap and affordable. However, it contains anti-nutritive factors which inhibit the protein-enzymes activities. Therefore, enzyme use in poultry nutrition helps in inhibiting the activities of the anti-nutritional factors which interfere with feed digestion, nutrient distribution and invasion of pathogens. The aim of this 42-day research was to evaluate the impact of adding enzymes to soya pre-extrusion, through the assessment of effects of inclusion of treated soya on performance of male broiler chickens. Six dietary treatments with 8 replications were used (diet A with no enzyme, diet B, C, D, E, and F with enzyme supplementation) on 288 male Ross 308 broilers chickens. Weekly records of bird weigh, feed intake and body weight gain were taken to determine the impact of enzyme addition of soybean pre-extrusion on performance. No significant effect between diets with enzyme pre-treatment and diets with no enzyme pre-treatment on performance of male broilers. Birds fed diet B showed optimal performance improvement of FCR (1.44) and BWG (1000g) at week two and six respectively compared to other dietary treatments. However, the precision of the results obtained using the same enzyme-inclusion level is limited. In order to draw final conclusions, future research is needed to evaluate the impact of enzyme pre-treatment on extruded soybean in diets using different enzyme inclusion levels, large sample size. Lastly, for sustainable source of protein, more effort should be focus on developing alternative protein source rather than depending on imported protein source from other countries.**

Keywords: **Broiler, enzyme, extrusion, soybean, performance.**

1. INTRODUCTION

The global demand for meat in the past 20 years was 173 million tonnes, of which 23% was poultry. The annual meat demand today is 285 millions tonnes globally, with 35% (approximately 100 million tonnes) from the poultry industry as shown in figure 1.1 (Rabobank, 2011). The increase in meat demand is the main driver for the increase in poultry meat production, making it the meat of choice globally. Consumers readily accept poultry meat due to its availability, versatile nature and its nutrient contribution in the diet (Garnaut, 2011). Compared to other meat, globally it is popular due to its low price, nutritional value and lack of religious or cultural barriers hindering the production and consumption (Magdelaine et al., 2008).

In anticipation of the need for a secure global food supply, there is the need to increase meat production by 40% and 70% by 2030 and 2050 respectively, to meet rising world population (OECD-FAO, 2009). Therefore, poultry meat is expected to become the most consumed meat type representing 39% of protein source consumed by 2030 (Rabobank, 2011).

The discovery of Bovine spongiform encephalomyelitis (BSE) and Jakob disease in humans in 2001, has led to the total ban of animal products as a protein source in animal nutrition in the EU (TSER 999/2001; ABPR 1774/2002). Although plant proteins are generally cheap compared to animal protein, the anti-nutritional factors present in these plant proteins necessitates further processing before it is used. Several methods such as heat processing and extrusion has been used in improving the nutritional value of the ingredients (Adeyemo and Longe, 2007).

Enzyme use in poultry feed:

Enzymes have played a vital role since the 1980s in meeting the quality feed demands of consumers. They play a vital role in the poultry industry by changing the nutritional profile of ingredients (Wallis, 1996). Specifically, in the poultry and pig industries, feed enzymes target the anti-nutritional factors in feed, thereby improving feed efficiency and utilisation. More so, animal manure which has a negative impact on the environment is reduced by the used of feed enzymes.

The aim of this study was to examine the impact of adding enzymes to soy pre extrusion on gut development and performance of male broiler chickens fed diets including enzyme pre-treated soy.

2. MATERIALS AND METHODS

Ethics:

All procedures carried out for the purpose of this research were part of a larger project, already with ethical clearance from the ethical review committee and the School of Animal, Rural and Environmental Science NTU. In this study, none of the procedures undertaken required a Home Office Project Licence.

Subjects and Husbandry of Birds:

In order to evaluate the impact of adding enzymes to soy pre extrusion, and the effects of including this treated soy in broiler diets on gut development and performance of male broiler chickens. Male Ross 308 broilers were ordered and collected at P.D. Hook Hatcheries LTD (Cote, Oxfordshire, UK) on the hatching day. A total number of 288 chicks were needed for the trial but additional chicks were included so as to replace the number of birds that died during transportation. Prior to the distribution of birds in the pen, birds with signs of ill-health and unusual size were removed from the population when inspected and weight using a top pan balance. Birds within the range of 39 and 47g were used for the trial for a uniform growth. Using cervical dislocation, the remaining chicks were humanely culled and disposed properly. Prior to the bird's arrival, the study room was cleaned, disinfected and pre-heated at 31®C using infrared heater. The trial room was partition into 48 pens at 0.7 m^2, 5 cm depth wood shaving were used as bedding material to regulate welfare issues such as footpad dermatitis. The pens were respectively partitioned into 6 groups of 8 pens, with 6 birds allocated to each pen. With the inclusion of the control group as A, pens were labelled as B-F. The 6 treatments were fed with extruded soy with the inclusion of appropriate treatments in the starter diet. *Ad libitum* feed and water was provide to birds using feeding troughs and nipple drinker respectively. Birds are managed using controlled temperature and ventilation which are regulated according to behavioural changes and the age of the birds as recommended by animal welfare act 2006. Lighting of the study room was provided according to the age of the birds as recommended by animal welfare regulations. Records of daily temperature and humidity in the trial room was maintained, health check and behavioural monitoring was maintained twice daily so as to assess the welfare of the birds. Disabled and diseased birds were humanely culled using cervical dislocation and disposed properly.

Experimental diets use:

A - Control extruded soy (no enzyme)

B - Extruded soy with Cellulase type 1

C - Extruded soy with Cellulase type 2

D- Extruded soy with Pectinase

E - Extruded Soy with Phytase

F - Extruded Soy with Trypsin

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Birds Performance:

Weekly performance of the birds was determined by measuring the body weight gain (BWG), feed conversion ratio (FCR).

III. RESULTS

Effects of pre-extrusion treatment of soybean on performance of experimental bird

The effects of an extruded soybean diet supplemented with or without enzymes on Feed conversion ratio (FCR) and body weight gain (BWG) of birds on dietary treatments from week 1 to week 6 are shown in Table below. There were no significant (p>0.05) differences observed in FCR and BWG of birds on extruded soybean with or without enzyme supplementation throughout the experiment,

Table 1: Effects of pre-extrusion enzyme treatment of soybean on feed conversion ratio (g feed intake/g BWG) of the experimental birds fed diets containing extruded soybean

	Weeks					
Diet	**1**	**2**	**3**	**4**	**5**	**6**
A	2.24	1.53	1.60	1.58	1.54	1.57
B	1.90	1.44	1.62	1.66	1.58	1.53
C	2.05	1.67	1.81	1.76	1.59	1.58
D	1.81	1.59	2.20	1.69	1.54	1.58
E	1.82	1.56	1.65	1.78	1.52	1.60
F	1.86	1.57	1.76	1.59	1.57	1.71
P- value	0.474	0.661	0.519	0.590	0.805	0.268
SEM	0.07	0.04	0.09	0.04	0.02	0.02

Table 2: Effects of pre-extrusion treatment of soybean on body weight gain (g) of experimental birds fed diets containing extruded soybean

	Week					
Diet	**1**	**2**	**3**	**4**	**5**	**6**
A	83	234	406	636	790	948
B	87	253	404	629	753	1005
C	83	238	369	593	743	952
D	89	243	376	600	750	952
E	91	251	408	572	767	907
F	88	247	373	626	724	862
P-value	0.680	0.786	0.582	0.361	0.742	0.153
SEM	1.70	4.26	8.41	9.69	12.03	15.61

IV. DISCUSSION

Effects of pre-extrusion treatment of soybean on performance of experimental bird fed diets containing extruded soybean:

The effects of experimental diets on the FCR of broiler birds from starter, grower and finisher showed no significant difference. Although a minimal impact has been observed with enzyme supplementation on the FCR at the finisher phase, but not in the grower period. The findings of this study conform with results of previous research on extruded soybean on broilers. Smlikowka *et al.* (2006) reported no significance difference on performance using the extruded soybean. Similarly, the work of Biggs *et al.* (2012) on extruded soybean supplementation with phytase and protease on Ros 308 and Ros 708 broilers, confirmed that there was no significant effect of the phytase on the BWG, FI and FCR, which is also in agreement with the present study. This could be attributed to the increased indigestibility of protein and starch in the ileum as found by Marsman *et al.* (1997) and Smulikowska *et al.* (2006). Some authors averred that poor performance of birds on extruded soybean could be due to the low nutrient utilisation, enzyme inclusion-level and the apparent decrease in digestibility of protein (Gatlin *et al.*, 2007; Cruz *et al.*, 2011; Seyed *et al*, 2013; Yan *et al.*, 2005). According

to Bedford and Morgan (1996) and Seyed *et al*. (2013), the degree of improvement seen by the addition of enzymes to diets depends on factors including the level of anti-nutritive factors in the animal's diet, enzyme inclusion-level, the concentration and spectrum of enzymes used, and quantity and type of grain used. Phosphorus is stored in plant seed in the form of phytic acid which binds to trypsin (Singh and Krikorian, 1982), similarly, phytic acid form complex with minerals and protein (phytate-mineral-protein) which inhibit the action of protein enzyme (Cruz *et al.,* 2011). When comparing diet A to other diet treatments which included enzymes, the poorer FCR may be due to the absence of phytase, which is required to deactivate the activity of anti- inhibitory substance (Yan *et al*., 2006). Non-beneficial effects of enzymes on extruded soybean diet on FI, BWG and FCR were reported by Cowieson and Ravindran (2008) and Francesch and Geraert (2009). However, in contrast to the study of Francesch and Geraert (2009), the supplementation of phytase and xylanase in soybeans improved FCR (Francesch and Geraert, 2009). The supplementation of both phytase and xylanase in soybean may hydrolyse arabinoxylans there by releasing the protein. The beneficial effects of the supplementation of phytase and xylanase leads to the reduction of anti-nutrient effects of phytate and feed efficiency and net energy improvement by xylanase (Cowieson, 2005)

At week six, an increase in BWG and good FCR compared to other weeks was observed in the treatments. In agreement with the work by Bernardo et al. (2012) the poorer FCR observed at the d0-d7 could be due to lower nutrient utilisation in chicks. Similarly, as reported by Choct *et al.* (1996), the response of enzymes activity depends on the age, physiology and gut microflora. This is because older birds have the ability to enhance the fermentation of microflora in the small intestine and also deal with the effects of high viscosity (Choct et al., 1996; Vranjes and Wenk, 1995). Supplementing enzymes in the diet has been proven to improve the performance of birds from day 28 to 44 by reducing the concentration of blood uric acid, which infers increased nutrient metabolism as result of enzyme supplementation (Hajati, 2010). The need for enzyme supplementation in broilers diet has been reported to have a positive and significant response on the performance of broilers fed with protease (Yu *et al.*, 2007; Ghazi *et al.*, 2002). Similarly, reduction in digesta viscosity with subsequently improved nutrient digestibility and broiler performance has been enhanced with enzyme supplementation (Lazaro et al., 2003). Rackis *et al.* (1986) and Kakade *et al.* (1973) reported that 40% reduction in production performance when broilers were fed extruded soybean, due to the presence of trypsin inhibitors. Similarly, there was a 20-40% performance and digestibility decrease when birds were fed extruded SBM (Qin, 1996). These findings are in disagreement with those of Perez-Maldonado *et al.* (2003), who reported a significant response in FCR and BWG. However, the results of the present study differ from those mentioned above. Non-significance effects of diets on performance response was similar to the report of Caine *et al.* (1996) who observed that using trypsin inhibitors in poultry feed decreased the performance and digestibility. Bernardo *et al*. (2012) and Perez-Maldonado *et al*. (2003) shared a similar view with Bedford (1996) that variations observed in growth performance of birds could be as a result of many confounding factors.

Moreover, the research conducted by Arija *et al.* (2006) shows that the supplementation of extruded soybean with enzyme had no effect on the weight and length of digestive organs and accessories (Jejunum and Ileum).

V. CONCLUSIONS

The overall findings of the present research showed that there was no significant effect of enzyme supplementation on the performance response of birds on dietary treatments used. This could be due to the inclusion level, characteristics of enzymes or some limitations observed which should be further examined.

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