



Sustainable Livestock Production in the Perspective of
Food Security, Policy, Genetic Resources, and Climate Change

Proceedings Full Papers

10-14 November 2014, Yogyakarta, INDONESIA



The 16th AAAP Congress



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Ministry of Agriculture



Indonesian Society of Animal Sciences



Gadjah Mada University

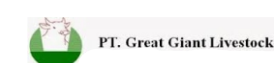
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**SUSTAINABLE LIVESTOCK PRODUCTION IN THE
PRESPECTIVE OF FOOD SECURITY, POLICY, GENETIC
RESOURCES, AND CLIMATE CHANGE**

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Asian-Australasian Association of Animal Production Societies

✧ **Scope of AAAP:** AAAP is established to devote for the efficient animal production in the Asian-Australasian region through national, regional, international cooperation and academic conferences.

✧ **Brief History of AAAP:** AAAP was founded in 1980 with 8 charter members representing 8 countries-those are Australia, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines and Thailand. Then, the society representing Taiwan joined AAAP in 1982 followed by Bangladesh in 1987, Papua New Guinea in 1990, India and Vietnam in 1992, Mongolia, Nepal and Pakistan in 1994, Iran in 2002, Sri Lanka and China in 2006 , thereafter currently 19 members.

✧ **Major Activities of AAAP:** Biennial AAAP Animal Science Congress, Publications of the Asian-Australasian Journal of Animal Sciences and proceedings of the AAAP congress and symposia and Acknowledgement awards for the contribution of AAAP scientists.

✧ **Organization of AAAP:**

- President: Recommended by the national society hosting the next biennial AAAP Animal Science Congress and approved by Council meeting and serve 2 years.
- Two Vice Presidents: One represents the present host society and the other represents next host society of the very next AAAP Animal Science Congress.
- Secretary General: All managerial works for AAAP with 6 years term by approval by the council
- Council Members: AAAP president, vice presidents, secretary general and each presidents or representative of each member society are members of the council. The council decides congress venue and many important agenda of AAAP

✧ **Office of AAAP:** Decided by the council to have the permanent office of AAAP in Korea. Currently # 909 Korea Sci &Tech Center Seoul 135-703, Korea

✧ **Official Journal of AAAP:** Asian-Australasian Journal of Animal Sciences (Asian-Aust. J. Anim. Sci. ISSN 1011-2367. <http://www.ajas.info>) is published monthly with its main office in Korea

✧ **Current 19 Member Societies of AAAP:**

ASAP(Australia), BAHA(Bangladesh), CAASVM(China), IAAP(India), ISAS(Indonesia), IAAS(Iran), JSAS(Japan), KSAST(Korea), MSAP(Malaysia), MLSBA(Mongolia), NASA(Nepal), NZSAP(New Zealand), PAHA(Pakistan), PNGSA(Papua New Guinea), PSAS(Philippines), SLAAP(Sri Lanka), CSAS(Taiwan), AHAT(Thailand), AHAV(Vietnam).

✧ **Previous Venues of AAAP Animal Science Congress and AAAP Presidents**

I	1980	Malaysia	S. Jalaludin	II	1982	Philippines	V. G. Arganosa
III	1985	Korea	In Kyu Han	IV	1987	New Zealand	A. R. Sykes
V	1990	Taiwan	T. P. Yeh	VI	1992	Thailand	C. Chantalakhana
VII	1994	Indonesia	E. Soetirto	VIII	1996	Japan	T. Morichi
IX	2000	Australia	J. Ternouth	X	2002	India	P. N. Bhat
XI	2004	Malaysia	Z. A. Jelani	XII	2006	Korea	I. K. Paik
XIII	2008	Vietnam	N.V. Thien	XIV	2010	Taiwan	L.C. Hsia
XV	2012	Thailand	C.Kittayachaweng	XVI	2014	Indonesia	Yudi.Guntara.Noor

Remark from Chairman of the 16th AAAP Congress

Dear all of the scientists, delegates, participants, ladies and gentlemen,

As the host of the 16th AAAP Animal Science Congress, we do impress, thankful, and present a high appreciation for your participation in joining the 16th AAAP Conference in Yogyakarta, Indonesia. We can see the very great enthusiasm of all the scientists to solve livestock problems as well as to share valuable information and knowledge for human prosperity all over the world.

A large numbers of representatives are participating in this conference, which indicates that the interest in the field of animal science is continuously increasing among member countries. We have invited some Plenary Speakers and Invited Papers who are qualified as scientists and bureaucrats in animal science field to share their valuable information and knowledge. Other participants can deliver their precious research through oral and poster presentations. This congress is also paralleled to symposium held by livestock organization and institution as well as some academic meetings.

The theme of the 16th AAAP Congress is “Sustainable Livestock Production in the perspective of Food security, Policy, Genetic Resources and Climate Change”. We believe that animal production in Asia and Australasia has become important and strategic sector to provide high quality food, opening up job opportunities, as well as improving farmer’s welfare. Animal science societies, therefore, have to support this growing interest by providing more appropriate and relevant technologies to improve efficiency of resources utilization to produce more animal protein food by member countries. Long term sustainable livestock production will, therefore, be significantly influenced by the national food policy, climate change issues, as well as conserved environments and genetic resources.

On behalf of 16th AAAP Committee and all associates, we wish all of the participants having a great achievement of success and fulfill the expectation as well as enjoying the interaction with all scientists participating the Congress.

High appreciation we may acknowledge to all of sectors, especially for His Majesty of Royal Palace of Yogyakarta, Sri Sultan Hamengku Buwono X, and Rector of Universitas Gadjah Mada, who have concerned to facilitate the Congress site host. Special thank to the Steering Committee, Scientific Committee, Reviewers and Editorial Boards for their great contribution to make the Congress successfully organized.

To you, your excellencies, invited guests and delegates, thank you for choosing to come to this conference and to Indonesia. We hope the arrangements we have put in place meet with your requirements. We wish you fruitful deliberations and an intellectually and socially rewarding stay in Yogyakarta.

We are looking forward to meeting you all in the future congress to continue.

Terimakasih (Thank you)



Budi Guntoro

Chairman of the 16th AAAP Congress

16th AAAP PRESIDENT'S REPORT

Selamat pagi!

Dear Ladies and Gentleman

Attendants of 16 AAAP congress:

It is my great pleasure and honor to welcome all of you at The 16th AAAP Congress on November 10 – 14, 2014 at Grha Sabha Pramana, Universitas Gadjah Mada, Yogyakarta Indonesia. This Congress is jointly organized by The Indonesian Society of Animal Science (ISAS), Indonesian Agency for Agricultural Research and Development, Indonesian Directorate General of Livestock and Animal Health Services-Ministry of Agriculture and Faculty of Animal Science Universitas Gadjah Mada. Universitas Gadjah Mada Campus is located in Yogyakarta, one of the Special Region in Indonesia where culture and tradition live in harmony with the modern nuance and educational spirit makes it a beautiful venue of this Congress.

The 16th AAAP Program consists of scientific and technical programs as well as social and cultural activities. The scientific and technical programs offer five plenary sessions, two satellite symposia, field trip, and many scientific sessions, both oral and poster presentations.

During this event distinguished scientists from all over the world will present plenary papers ranging from livestock policy, food security, local genetic resources, climate change, animal welfare, international trade, as well as global research agenda. I believe that around 1,200 scientists as well as livestock producers, companies, graduate and postgraduate students from 40 countries are attending the Congress and more than 770 research papers will be presented. The Congress also provides not only opportunities to discuss and exchange information and experience with scientists from different regions of the world, but also a good environment to build up friendship between nations is our ultimate goals for the Congress outcome. Moreover, this congress also keeps its tradition to be a forum of communication among researchers, academician, industries and related stakeholders among Asian-Australasian countries.

The social and cultural programs are specially designed to be very important for the congress participants since the promotion of friendship and future scientific cooperation are also central to this AAAP Congress. The Opening Ceremony will offer you the Congress Program at a glance. In addition, participants will also join at a warm Welcome Dinner gathering at Keraton Yogyakarta. Sri Sultan Hamengku Buwono X, His Majesty of The Royal Palace of Yogyakarta will give you the most memorable moment during this event.


Moreover, cultural night offers us an opportunity to introduce significant culture from participants' countries and gives a spectacular performance to enjoy in order to strengthen our friendship and future cooperation. Field trip, on the other hand, provides a wonderful sightseeing to the most valuable ancient heritage around Yogyakarta, such as Borobudur and Prambanan Temples, and more other interesting places to visit. I do hope that you enjoy your stay in Yogyakarta and not miss all of these spectacular opportunities.

Closing Ceremony will be held on November 14, 2014 immediately after the last session of presentation. During this great moment we will welcome the next host of the 17th AAAP Congress to deliver a brief message. The AAAP Congress Award will provide and announce some participant who receive appreciation for their valuable research.

With all of our hospitality, we will try our best to make your brief visit to Yogyakarta and our beautiful country Indonesia, become a wonderful experience and memorable moments.

I wish you all a very pleasant and most enjoyable stay in Yogyakarta, Indonesia.

Terima kasih (Thank you).

A handwritten signature in black ink, appearing to read 'Y. Guntara Noor', written over a diagonal line that extends from the bottom left towards the middle right.

Sincerely Yours
Mr. Yudi Guntara Noor
President
The 16th AAAP Congress

PREFACE

The proceedings of the 16th Congress of the Asian-Australasian Association of Animal Production Societies (AAAP) held on 10-14 November 2014 at Grha Sabha Pramana, Universitas Gadjah Mada, Yogyakarta, Indonesia, consist of two volumes. Those are Volume I of Plenary and Invited Papers and Volume II of Abstracts Contributed Papers. This is the second volume of the proceedings that contains a total of 754 abstracts, consist of 368 papers for oral presentation and 386 papers for poster. Papers were categorized into various disciplines, such as Nutrition and Feed Technology; Genetics and Reproduction; Physiology, Animal Welfare and Health Management; Product Technology and Food Safety; Waste and Environmental issues; Forage Agrostology; as well as Agribusiness, Marketing, Extension and Community Development. The scientific committee has initially received a total of 1,028 abstracts from 42 countries. After reviews have been made, 60 of them were rejected and 74 were cancelled by the authors. The reviewers consist of 4 international and 71 internal reviewers from 6 universities and 1 research institute in Indonesia. In the interest of time limitation for proceedings publication, we apologize for not including 140 submitted abstracts in the proceedings since they were not being followed up with full manuscripts until the extended due date we offered.

The scientific committee would like to thank all the reviewers and appreciate their effort to make significant contribution in reviewing the full manuscripts. Similarly, we would also like to thank supporting staffs at the secretariat office of the Faculty of Animal Science, Universitas Gadjah Mada as well as of the Indonesian Center for Animal Research and Development who have helped in the preparation of the proceedings. Finally, we would like to thank all the authors for their valuable contribution to the congress and make it useful for our societies.

Editorial Team

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Response of Broiler Chickens to Diets Based on Triticale and Supplemented with Microbial Enzymes

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ABSTRACT

A total of 384 day-old male Ross 308 broiler chicks were allocated to 8 dietary treatments, to examine the influence of supplementation xylanase and phytase, individually or in combination, in diets based on two cultivars of triticale (Bogong and Canobolas) on the growth response, visceral organ development as well as some physiological responses. The inclusion of phytase alone in either Bogong or Canobolas diets increased ($p < 0.01$) feed intake and body weight while the inclusion of xylanase tended to increase ($p = 0.063$) the feed intake to day 21. The ileal digestibility of crude protein, gross energy, starch, calcium and phosphorus was increased by the inclusion of phytase ($p < 0.01$) and xylanase ($p < 0.05$). There was an interaction ($p < 0.01$) between xylanase and phytase on the the digestibility of crude protein, gross energy, calcium and phosphorus. Ileal viscosity was significantly decreased ($p < 0.05$) by the inclusion of xylanase and phytase individually or in combination. The relative weight of various visceral organs was affected to different degrees by grain type and enzyme supplementation. Enzyme supplementation of the diets proved to be beneficial, and such response was due to an improvement in digestibility.

KeyWords: Triticale, Xylanase, Phytase, Intestine, Broiler chickens

INTRODUCTION

The nutritive value of older cultivars of triticale as the sole cereal grain in diets for poultry is generally reported poor (Smith et al., 1989). This is due to the presence of non-starch polysaccharides (NSP), which are mainly arabinoxylans and β -glucans (Pourreza et al., 2007) and also phytic acid (Jondreville et al., 2007). Nevertheless, supplementation with exogenous carbohydrase enzymes, such as xylanase, can reduce the viscosity of the intestinal contents and improve the digestibility of starch, protein and energy in broiler diets (Annison and Choct, 1991 and Bedford, 1995). Likewise, the inclusion of phytase in the broiler diet can increase feed utilisation and body weight (Huff et al., 1998 and Levic et al., 2006). Newer cultivars are being developed around Australia, with higher grain yield and protein content than the older cultivars. However, their nutritive value for poultry has not been extensively tested. The objective of this trial was to examine the influence of supplementation with xylanase and phytase, individually or in combination, in diets based on two new cultivars of triticale (Bogong and Canobolas) on the gross response, ileal digestibility as well as visceral organ weight of broiler chickens.

MATERIALS AND METHODS

This was a 2 x 2 x 2 factorial experiment with 2 cultivars of high-yielding triticale (Bogong and Canobolas), with or without xylanase and with or without phytase. Each diet was formulated to contain triticale (650 g/kg) as the sole cereal grain. The dietary treatments were as follows: a diet based on Bogong without any enzymes (B); Bogong supplemented with xylanase (BX); Bogong with phytase (BP); Bogong with xylanase and phytase (BXP); Canobolas without enzymes (C); Canobolas supplemented with xylanase (CX); Canobolas with phytase (CP) and Canobolas with xylanase and phytase (CXP).

A total of 384 day-old male Ross 308 broiler chicks (initial weight 41.30±0.35 g), were randomly allocated to 48 cages. Each of the 8 treatments was randomly assigned to 6 cages with 8 birds per cage. On days 7 and 21, one bird and three birds, respectively, from each cage, were randomly selected, weighed and killed by cervical dislocation. Nutrient digestibility was also measured, using TiO₂ as a marker. All data were subjected to the analysis of variance using General Linear Model (GLM) of Minitab 16.0 software. Differences were considered significant at $p < 0.05$.

Table 1. Feed intake (FI), body weight (BW) and feed conversion ratio (FCR) of chickens on triticale-based diet with or without enzymes between hatch and 7 or 21 d of age¹

Treatments			1-7 days			1-21 days		
Grain	Xyl ²	Phy ³	FI (g/bird)	BW (g/bird)	FCR (g/g)	FI (g/bird)	BW (g/bird)	FCR (g/g)
Bogong	-	-	146.3 ^c	180.8 ^{cd}	1.05	1008.7 ^{de}	813.7 ^b	1.31
Bogong	+	-	147.2 ^c	182.8 ^{cd}	1.04	1043.0 ^d	826.6 ^b	1.33
Bogong	-	+	167.5 ^a	201.7 ^a	1.04	1385.5 ^a	1071.9 ^a	1.35
Bogong	+	+	164.6 ^{ab}	198.3 ^{ab}	1.05	1275.6 ^c	1045.4 ^a	1.27
Canobolas	-	-	147.4 ^c	178.1 ^d	1.08	954.9 ^e	775.2 ^b	1.31
Canobolas	+	-	154.1 ^{bc}	189.1 ^{bc}	1.04	961.1 ^e	788.0 ^b	1.29
Canobolas	-	+	168.3 ^a	201.2 ^a	1.05	1373.6 ^{ab}	1066.0 ^a	1.34
Canobolas	+	+	170.8 ^a	199.4 ^a	1.08	1305.1 ^{bc}	1048.4 ^a	1.30
Pooled SEM ⁴			1.94	1.79	0.005	27.00	20.20	0.010
Source of variation			Significance of treatment effect					
Grain			ns	ns	0.056	ns	ns	ns
Xylanase			ns	ns	ns	0.063	ns	ns
Phytase			**	**	ns	**	**	ns
Grain x Xylanase			ns	ns	ns	ns	ns	ns
Grain x Phytase			ns	ns	ns	*	ns	ns
Xylanase x Phytase			ns	0.081	0.067	**	ns	ns
Grain x Xylanase x Phytase			ns	ns	ns	ns	ns	ns

¹Each value represents the mean of 6 replicates. ²Xylanase. ³Phytase. ⁴SEM = Standard error of mean.

^{a-d}Values with unlike superscripts within each column are significantly different at * $p < 0.05$; ** $p < 0.01$.

ns = not significant.

RESULTS DISCUSSION

Feed intake to day 7 was increased ($p < 0.01$) by the inclusion of phytase to both diets. Body weight of birds at 7 and 21d was also increased ($p < 0.01$) by the inclusion of phytase. There was no significant interaction between grain and xylanase for all parameters measured, except for a significant interaction ($p < 0.05$) between grain and phytase as well as between xylanase and phytase ($p < 0.01$) on the feed intake to 21d (Table 1.).

The digestibility of crude protein increased by 9.4% with the inclusion of phytase in the Bogong diet, while the inclusion of the combination of supplemental xylanase and phytase increased by 11.5% in the Canobolas diet. The digestibility of gross energy was increased ($p < 0.05$) by the inclusion of xylanase and the inclusion of phytase ($p < 0.01$) and the interaction between the inclusion of xylanase and phytase ($p < 0.01$). Likewise, the digestibility of starch was increased ($p < 0.05$) by the inclusion of xylanase and phytase ($p < 0.01$).

The ileal digestibility of Ca was increased ($p < 0.05$) by the inclusion of xylanase and the interaction ($p < 0.01$) between xylanase and phytase. Similarly, the ileal digestibility of P was

significantly increased ($p < 0.05$) by the inclusion of xylanase and phytase ($p < 0.001$), as well as the interaction ($p < 0.01$) between xylanase and phytase. The inclusion of enzymes increased P digestibility by about 13.4 to 29.0% and 30.0 to 35.0%, in the Bogong and Canobolas diets, respectively.

There was no statistically significant effect of xylanase and phytase inclusion on the relative weight of any of the visceral organs examined; however, the relative weight of the proventriculus plus gizzard of birds on the Bogong diets was less ($p < 0.01$) than that on the Canobolas diets.

On day 21 the only significant effect of the inclusion of enzymes in the diets was on the relative weight of liver, which was decreased ($p < 0.001$) by the inclusion of phytase in the diets.

The highest FI and BW were found in the diets with only phytase inclusion. These diets also exhibited the highest CP, GE, starch and P digestibility. This finding, however, was unexpected, because the ileal viscosity of birds on the diet with only phytase supplementation was significantly higher than that of birds on the diets containing only xylanase or those containing a combination of supplemental xylanase and phytase. This phenomenon may be the result that the microbial phytase used in the present study was produced by solid state fermentation and contains significant activities of beta-glucanase and xylanase (Wu et al., 2004).

IMPLICATIONS

Supplementation with phytase alone or combination of phytase and xylanase further improved productivity. The beneficial effect of exogenous enzymes may be due to improvement in the digestibility of CP, gross energy, starch, Ca and P.

REFERENCES

- Annison, G. and Choct, M. (1991). Anti-nutritive activities of cereal non-starch polysaccharides in broiler diets and strategies minimizing their effects. *World's Poult. Sci. J.*, 47, 232-242.
- Bedford, M. R. (1995). Mechanism of action and potential environmental benefits from the use of feed enzymes. *Anim. Feed Sci. Technol.*, 53, 145-155.
- Jondreville, C., Genthon, C., Bouguennec, A., Carre, B. and Nys, Y. (2007). Characterisation of European varieties of triticale with special emphasis on the ability of plant phytase to improve phytate phosphorus availability to chickens. *Br. Poult. Sci.*, 48, 678-689.
- Oettler, G. (2005). The fortune of a botanical curiosity – Triticale: past, present and future. *J. Agr. Sci.*, 143, 329-346.
- Pourreza, J., Samie, A. H. and Rowghani, E. (2007). Effect of supplemental enzyme on nutrient digestibility and performance of broiler chicks fed on diets containing triticale. *Int. J. Poult. Sci.*, 6, 115-117.
- Smith, R. L., Jensen, L. S., Hoveland, C. S. and Hanna, W. W. (1989). Use of pearl millet, sorghum, and triticale grain in broiler diet. *J. Prod. Agric.*, 2, 78-82.
- Wang, Z., Qiao, S., Lu, W. and Li, D. (2005). Effects of enzyme supplementation on performance, nutrient digestibility, gastrointestinal morphology, and volatile fatty acid profiles in the hindgut of broilers fed wheat-based diets. *Poult. Sci.*, 84, 875-881.
- Wu, Y. B., Ravindran, V., Thomas, D. G., Birtles, M. J. and Hendriks, W. H. (2004). Influence of phytase and xylanase, individually or in combination, on performance, apparent metabolisable energy, digestive tract measurements and gut morphology in broilers fed wheat-based diets containing adequate level of phosphorus. *Br. Poult. Sci.*, 45, 76-84.