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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The 16th AAAP Congress

Cataloguing-in-Publication Data

The 16th Asian-Australasian Associations of Animal Production Socities

Proceedings Full Papers

Sustainable Livestock Production in the Perspective of

Food Security, Policy, Genetic Resources, and Climate Change

10-14 November 2014, Yogyakarta, Indonesia / editors Subandriyo *et al*;

2825 p: ill.; 21 x 29,7 cm

Organized by Indonesian Society of Animal Sciences

In Collaboration with Ministry of Agriculture

Faculty of Animal Sciences Universitas Gadjah Mada

ISBN 978-602-8475-87-7

1. Livestock 2. Food Security 3. Policy

4. Genetic Resources 5. Climate Change

I. Title II. Subandriyo

AAAP

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. Jelan	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 socities, 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 desgined 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 hospitability, 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).

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

CONTENTS

ORAL PRESENTATION

POSTER PRESENTATION

Can Plant Saponins Lower Methane Emissions Without Hampering the Nutrient Digestibility of Ruminants

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ABSTRACT

Plant saponins have been used as additives to mitigate methane emissions originated from enteric fermentation of ruminant animals. Most of the studies however were based on *in vitro* techniques, and only limited studies were conducted on the animals. Inconsistencies of saponin effects on methane emissions have been previously observed, which might be related to their levels in rations. The present study was aimed to assess the effects of saponin levels on methane emissions and nutrient digestibility of ruminants *in vivo* by integrating data from multiple studies. A number of studies across 11 published articles were integrated into a database. Both small and large ruminant species were included. Searching of the articles was performed by using Scopus with keywords "saponin" and "methane". The main criteria for a paper to be included were: (i) studies were conducted *in vivo*, (ii) saponin contents were reported, and (iii) methane was directly measured, not estimated by any methods. Parameters included in the database were methane emissions and nutrient digestibility. Data were analyzed by the statistical meta-analysis approach based on mixed model methodology. Different studies were treated as random effects while saponin levels in diets, i.e. control (no saponins), low ($0 <$ saponins ≤ 5 g/kg) and high (saponins > 5 g/kg), were considered as fixed effects. Results revealed that, across all studies, methane emissions decreased significantly when saponins were added at both low and high levels ($P<0.05$), suggesting that the use of saponins for ruminants is beneficial in term of environmental conservation. Low levels of saponins increased nutrient digestibility as compared to control ($P<0.05$) while, on the contrary, high levels decreased the nutrient digestibility ($P<0.05$). It can be therefore concluded that the use of saponins at low levels is able to lower methane emissions of ruminants without hampering their digestibility.

Key Words: Saponin, Methane, Ruminant, Production, Meta-analysis

INTRODUCTION

Ruminants are among the contributors of methane accumulation in the atmosphere and contribute to global warming (Moss et al., 2000). Such methane emission is also a form of energy loss from the animals which may account up to 14% loss from digestible energy intake (Cottle et al., 2011). Plant saponins have been used as additives to mitigate methane emissions originated from enteric fermentation of ruminant animals. Most of the studies however were based on *in vitro* techniques, and only limited studies were directly conducted on the animals. Inconsistencies of saponin effects on methane emissions have been previously observed (Lila et al., 2005; Li and Powers, 2012), which might be related to their levels in rations. Furthermore, nutrient digestibility was varied by addition of plant saponins. The present study was therefore aimed to assess the effects of saponin levels on methane emissions and nutrient digestibility of ruminants *in vivo* by integrating data from multiple studies.

MATERIAL AND METHODS

Database Development. Reports on the use of saponins to mitigate *in vivo* methane emissions of ruminants were integrated in a database; both small and large ruminant species

were included. Searching of literatures was performed by using the Scopus database with keywords "saponin" and "methane". The main criteria for a paper to be included were: (i) studies were conducted *in vivo*, (ii) saponin contents were reported, and (iii) methane was directly measured, not estimated by any methods. Data originated from *in vitro* rumen fermentation experiments were excluded and reported elsewhere (Jayanegara et al., 2014). Accordingly, a total of 11 articles comprised of 17 studies were obtained and used to construct the database. Apart from information on saponin sources, application levels and methane emissions, nutrient digestibility was also recorded, i.e. dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF) digestibility. After collection, different units of measurements within a particular parameter were transformed into similar units in order to allow direct analysis. Various plant sources of saponins were tabulated, i.e. sapindus, yucca, quillaja, alfalfa and tea. Saponin levels (ranged from 0 to 40 g/kg) were classified into three groups, namely control (no saponins), low ($0 <$ saponins ≤ 5 g/kg) and high (saponins > 5 g/kg) levels. Justification of 5 g/kg of saponins to separate the low and the high saponin groups was based on the average saponin levels across all studies included in the database.

Statistical Analysis. The data obtained were subjected to a statistical meta-analysis based on mixed model methodology (Sauvant et al., 2008). Accordingly, different studies were treated as random effects whereas categorical levels of saponin additions were considered as fixed effects. The following statistical model was used:

$$Y_{ij} = \mu + s_i + \tau_j + s\tau_{ij} + e_{ij}$$

where Y_{ij} = dependent variable, μ = overall mean, s_i = random effect of the ith study, τ_j = fixed effect of the jth level of factor τ, $s\tau_{ij}$ = random interaction between the ith study and the jth level of factor τ, and e_{ij} = the unexplained residual error. No weighting procedure was applied for different studies. When a variable showed significant difference at $P<0.05$ between various saponin levels, Duncan's multiple range test was employed to compare the difference between means. All statistical analyses were performed with IBM SPSS Statistics version 20.

RESULTS AND DISCUSSION

Across all studies, methane emissions decreased significantly when saponins were added at both low and high levels ($P<0.05$) (Figure 1), suggesting that the use of saponins for ruminants is beneficial in term of environmental conservation. The decrease of methane emissions due to saponin additions at low and high levels was 8.6% and 7.3% lower than that of control, respectively. There was no statistical difference between administration of low and high levels of saponins on enteric methane emissions. Saponins lower methane emissions through a direct inhibition on methanogen population in the rumen (Narvaez *et al.*, 2013) and an adverse effect on the activity of methanogen (Guo *et al.*, 2008). Saponins also reduce a certain population of protozoa where part of the methanogens is living symbiotically with the fauna. Further, protozoa provide hydrogen as a substrate for methanogenesis (Morgavi *et al.*, 2010). Therefore, such decrease of protozoa population may lead to a decrease in methanogen population as well as methane emissions.

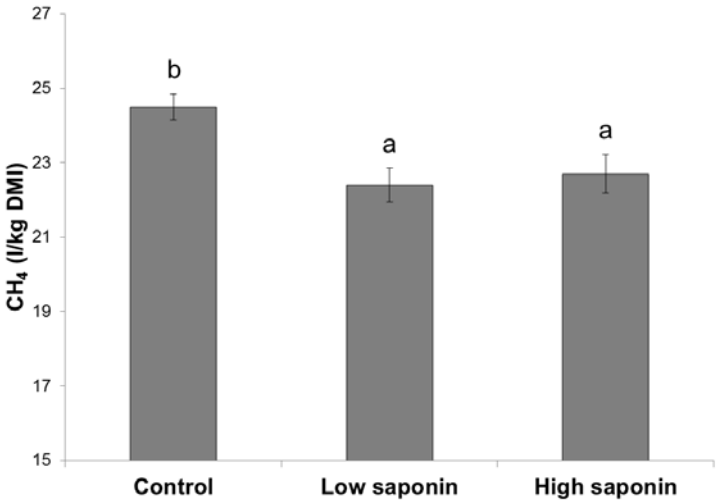

Figure 1. Influence of saponin additions at low (0 < saponins ≤ 5 g/kg) and high (saponins > 5 g/kg) levels on methane emissions (l/kg dry matter intake) from ruminants. (Different letters above the bars show significantly different at P<0.05)

Low levels of saponins increased nutrient digestibility as compared to control (P<0.05) while, on the contrary, high levels decreased the nutrient digestibility (P<0.05). Such pattern was true DMD, OMD, NDFD and ADFD (Table 1). In the case of CP digestibility, addition of saponins at low levels did not significantly improved the digestibility parameter but it was significantly higher than that of high saponin additions (P<0.05). Apparently, saponins at low levels (e.g. less than 5 g/kg) are favourable in simultaneously mitigating enteric methane emissions and stimulating nutrient digestibility. When being added at high levels, saponins seem to cause an adverse effect on nutrient digestibility without any further reduction in methane emissions. Therefore, since there is no advantage of adding saponins at high levels, the addition is sufficient at low levels.

Table 1. Digestibility of nutrients on saponin additions at low (0 < saponins ≤ 5 g/kg) and high (saponins > 5 g/kg) levels

Parameter	N	Control	Low saponin	High saponin	SEM
DMD (g/kg)	13	647^{b}	663^{c}	603^{a}	13.7
OMD (g/kg)	20	650^{b}	701^{c}	611^{a}	17.2
CPD (g/kg)	26	629^{ab}	645^{b}	620^{a}	15.1
NDFD (g/kg)	26	545^{b}	583^{c}	509^{a}	19.5
ADFD (g/kg)	21	486^{b}	537^{c}	454^{a}	28.4

DMD, dry matter digestibility; OMD, organic matter digestibility; CPD, crude protein digestibility; NDFD, neutral detergent fiber digestibility; ADFD, acid detergent fiber digestibility; N, number of data; SEM, standard error of the mean.
Different superscripts within the same row show significantly different at P<0.05.

CONCLUSION

The results revealed that, across all studies, methane emissions decreased significantly when saponins were added at both low and high levels, suggesting that the use of saponins for ruminants is beneficial in term of environmental conservation. Low levels of saponins increased nutrient digestibility as compared to control while, on the contrary, high levels decreased the nutrient digestibility. It can be therefore concluded that the use of saponins at low levels is able to lower methane emissions of ruminants without hampering their digestibility.

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