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PROCEEDING

4th International Seminar of AINI (ISAINI) 2015 "Recent Advance in Animal Nutrition and Feed Technology to Support Sustainable Livestock Production System".

Faculty of Animal Husbandry, Sam Ratulangi University, Manado North Sulawesi
Pennisula Hotel, Manado 8-9 September 2015

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Manado, Sulawesi Utara, Indonesia

PROCEEDING

4th International Seminar of AINI (ISAINI) 2015 "Recent Advance in Animal Nutrition and Feed Technology to Support Sustainable Livestock Production System".

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WELCOMING SPEECH
PRESIDENT OF AINI

Assalamu 'alaikum Wr. Wb.,

His Excellency Governor of North Sulawesi

The honorable Rector of The University of Sam Ratulangi,

The Dean of Faculty of Animal Science, University of Sam Ratulangi,

Distinguish guests, participants, ladies and gentlemen,

First of all, on behalf of the Indonesian Animal Nutritionist and Feed Scientist Association (AINI), I would like to extend our warmest welcome, and indeed it is a great pleasure to see you all in this room, participating in the 4^{td}*International Seminar and 10*th *Biennial Meeting of* AINI held in Manado North Sulawesi. At this time being, AINI is almost 20 years old since its first establishment in 1996 at Bogor. AINI was created with the objectives to gather all of the animal nutrition and feed scientists in Indonesia permitting to the exchange of knowledge and experiences under spirit of brotherhood, to stimulate the advancement of science and technology in nutrition and feed science, thus benefiting to the competitiveness of livestock agribusiness.

As the president of AINI since 2007, I and all of board committee member have been trying to do the best we could do for AINI being better well known at the national and International level. This International seminar is conducted with the objective also to serve better the AINI member on new research finding and provide the forum of meeting and exchange among scientists. We have successfully conducts regular international seminar every two years, thanks to the efforts of all AINI member have been dedicated to. The first international conference was held in UNSOED Purwokerto (2009), the second was held in UNPAD Bandung (2011), the third was held in UNAND Padang West Sumatera (2013), and the forth International seminar is held here at UNSRAT Manado North Sulawesi (2015).

Distinguish guests, participants, ladies and gentlemen,

The recommendation made by the 3rd International Seminar of AINI (ISAINI), held in Padang, was to recommend the Faculty of Animal Husbandry, Sam Ratulangi University, Manado, to be the host forthe 4th ISAINI 2015. The Theme of this International Seminar is "**Recent Advance in Animal Nutrition and Feed Technology to Support Sustainable Livestock Production System**". Sustainable livestock production system is now become the hot issue. The huge demand of animal products such as meat egg and milk to cover the growing population in the world should be handled with care without destroying the environment.Environment and its quality are becoming more and more degrading and reducing. Indeed, the effects of global warming could be feeling now with for example the longer dry session period that might reduce even destroy agricultural products and its productivity.In the case of Indonesia, it is projected that the demand of animal products will increased significantly while the national production is not sufficient enough to cover the demand. High price of red meat

and fluctuation of poultry meat price recently indicate the phenomenon of the imbalance supply-demand. We,as the scientist especially in animal nutrition and feed science, should engage and do our best to support the government policy in fullfiling the food of animal products, quantitative and qualitatively. In this regards, role of nutrition and also Nutritionist and Feed Scientist are very important, since the feed cost is the major component cost of livestock production. During this seminar, recent advance in animal nutrition and feed science will be shared and discussed to support the sustainable livestock production system.

Distinguish guests, participants, ladies and gentlemen,

On behalf of the AINI, at this opportunity, I should express my sincere thanks to the Dean of the Faculty of Animal Science University of Sam Ratulangi, the organizing committee, sponsors, and all party that cannot be listed since we are deeply in debt to all of your effort and sacrifice to the success of this seminar. Our sincere thanks and deepest gratitude must go to the invited speakers : Prof. Dr. Ir. Muladno, MSA (Director General of Livestock and Animal Health,Ministries of Agriculture of The Republic Indonesia); Prof. Abdul Razak Bin Alimon, PhD from Putra University, Malaysia; Prof. Cheol-Heui Yun, PhD from Seoul National University, South Korea; Dr. Ir. Osfar Sofjan, MSc from Brawijaya University Malang; Prof. Dr. Ir. David Arnold Kaligis, DEA from Sam Ratulangi University, Manado and Felipe Sanchez Fernandez from Throuw Nutrition. We are in debt to your effort and your participation in this event. Your views will enlighten and inspire all of the participants on how to develop sustainable livestock production system through the animal nutrition and feed science intervention.

Distinguish guests, participants, ladies and gentlemen,

I hope you will have the fruitful meeting and gaining many new ideas and perspectives to be developed in the future. I do hope also, we will see you again in the 5th International seminar and 11th Biannual meeting (ISAINI 2017)in which the hostwill be determined further by the board of committeemeeting during this event. Finally and surely, please enjoy your stay with North Sulawesi culture and nature, tradition and hospitality, in addition to your scientific activities.

Thank you

Wassalamu 'alaikum Wr. Wb.

Manado, September 8th, 2015
President of AINI

Prof. Dr. Ir. Ali Agus, DAA, DEA

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WELCOMING SPEECH

ORGINIZING COMMITTEE

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

As the host of the AINI International Seminar, we do impress, thankful, and present a high appreciation for your participation in joining the AINI International Seminar in Manado, Indonesia, the land of waving coconut trees. 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 nutrition and feed science field to share their valuable information and knowledge. Other participants can deliver their precious research through oral and poster presentations. This Seminar is also paralleled to Indonesian Association of Animal Nutritionist and Feed Scientists (AINI) Congress held by National Board.

The theme of the AINI International Seminar is *"Recent Advance in Animal Nutrition and Feed Technology to Support Sustainable Livestock Production System"*. We believe that animal production in Indonesia has become important and strategic sector to provide high quality food, opening up job opportunities, as well as improving farmer's welfare. Indonesian Association of Animal Nutritionist and Feed Scientists, therefore, have to support this growing interest by providing more appropriate, recent, and relevant technologies to supportsustainablelivestockproductionsystem to produce more animal protein food.

On behalf of AINI International Seminar 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' participants the Seminar.

High appreciation we may acknowledge to all of sectors, especially for Her excellency Rector of Sam Ratulangi University, who have concerned to facilitate the Seminar and Congress site host. Special thanks to the Steering Committee, Scientific Committee, Reviewers and Editorial Boards for their great contribution to make the Seminar and Congress successfully organized.

To you, you're Excellency, invited guests and delegates, thank you for choosing to cometo this Seminar and Congress and to Manado, 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 Manado.

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

***Terimakasih* (Thank you)**

Chairman of the 4th AINI International Seminar

Prof. Dr. Ir. BernatTulung, DEA

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KEYNOTE SPEAKERS

Prof. Dr. Ir. Muladno, MSA
Director General of Livestock and Animal Health,
Ministries of Agriculture of the Republic Indonesia

Professor Muladno was born in Kediri, East Java on 24 August 1961. He was educated for undergraduate education at Faculty of Animal Husbandry, Gadjah Mada University. His master of science in University of New England, Armidale, Australia in the area animal breeding and genetics. He completed his Ph. D at University of Sydney, Australia in molecular genetics. He pursued his post – doctoral at science and technology agency of Japan at National Institute of Animal Industry, Tsukuba Japan. Then from society for agricultural, forestry and fisheries (STAFF) Institute, Tsukuba, Japan and from Japan Society for Promotion of Science (JSPS) at Nagoya University, Japan and from Indonesian-Austalia Programme of specialized training on Intellectual Property Rights at Univerity of Technology, Sydney, Australia.

Prof. Abdul Razak Bin Alimon, Ph.D
Professor, Putra University, Malaysia

Professor Alimon was born on January 25, 1949. He was educated for his bachelor of science in the area of nutrition and physiology, postgraduate diploma of science and master of science in agriculture at University of New England, Australia. He completed his Ph. D at University of Reading in area of animal nutrition.

Prof. Cheol-Heui Yun, PhD
Professor, Seoul National University, Republic of Korea

Professor Cheol-Heui YUN grew up in Gwang-ju, a southwest of Republic of Korea. He was educated at the Chon am National University for B.Sc. and the Seoul National University for his M.Sc. in the area of Animal Nutrition. Professor Yun completed his Ph.D.at the University of Saskatchewan, Canada in the area of immune modulation and mucosal immunology. Then, he pursued his professional career at leading research institutes in different region of the world including International Vaccine Institute (IVI, Korea), United States Department of Agriculture (USDA, USA), National Institutes of Health (NIH, USA) and Gothenburg University (Sweden) where he undertook research related to vaccinology, infection biology and cellular immunity. Currently, he serves as editor of a number of societies including World Journal of Immunology, Frontiers in Molecular Innate Immunity, Journal of Biomaterials and Tissue Engineering, Scientific World Journal, Journal of Microbiology, and Science Editing. He was selected and serves as a vice Editor-in-Chief at Asian-Australasian Journal of Animal Sciences. Currently, he is the president of Korean Dendritic Cell Academic Society. Recently, his interest has focused on the action mechanism of vaccine and vaccine adjuvants against a various (mucosal) diseases in mouse as a model system and ultimately domestic animals.

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Dr. Ir. Osfar Sjofjan, MSc
Faculty of Animal Husbandry, Brawijaya University, Malang, Indonesia

Dr. Osfar was educated for B.Sc in Animal Husbandry at Padjajaran University and M.Sc in Poultry Feed at Wageningen Agricultural University, The Netherlands. He pursued his doctoral in Animal Science at University of Padjajaran, Bandung. His interest in Animal Nutrition.

Prof. Dr. Ir. David Arnold Kaligis, DEA
Professor, Faculty of Animal Husbandry, Sam Ratulangi University, Manado, Indonesia

Professor Kaligis was born in Semarang on December 9, 1948. He was educated at Faculty of Animal Husbandry, Sam Ratulangi University (Undergraduate), Universite Science et Technique du Languedoc Montpellier, France for his master and doctor in agronomi option zootechnique. His interest in forages sciences.

Felipe Sanchez Fernandez
Trouw Nutrition Application and Solution Center
Poultry Specialist and Technology Transfer

Veterinarian bachelor marketing and sales management master degree. More than 20 years working in poultry production as Poultry Product Manager, in Cargill Animal Nutrition and Nutreco compound feed business, with direct responsibilities on poultry nutrition, technical consultancy services and business development manager. In 2012, he was appointed to Trouw Nutrition Application and Solution Centre when he lead R and D projects and transfer innovations and technology to Nutreco operative companies.

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THE EFFECT OF FEEDING ZINC (Zn) AND VITAMIN E FORTIFIED DIETS ON DUCK EGG QUALITY STORED AT DIFFERENT TEMPERATURE DURING 21 DAYS

Sumiati[1)], Widya Hermana[1)], Arif Darmawan[1)], Neni Nuraeni[1)]
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ABSTRACT

Egg's yolk contain omega-3 and omega-6 fatty acid that easily oxidized during storage, so it needs to be protected. The objective of this study was to evaluate the effect of feeding Zn and vitamin E fortified diets on duck egg quality stored at different temperature during 21 days. This study used a completely randomized design (CRD) 15 treatment, 3 replication. The treatment were combination treatment diet (R1, R2, R3, R4, R5), stored temperature (T30 and T5) and stored periode (D0 and D21). The treatment diets were R1 (control diet), R2(R1+40 IU of vitamin E), R3(R1+80 IU of vitamin E), R4 (R1+100 ppm ZnOrganic), and R5(R1+200 ppm ZnOrganic). Ninety duck eggs used in this study. Parameters observed were egg weight, the percentage of eggshell weight, albumen weight and yolk weight, *haugh unit,* yolk color score, and eggshell thickness. The results showed that fortification of Zn 200 ppm in the diet could maintain the egg quality stored at room temperature (30 °C) during 21 days. Fortification of vitamin E 80 IU in the diets was able to maintain the egg quality at refrigerator (5 °C) during 21 days. It concluded that fortification Zn and vitamin E in the diet could maintain the quality of duck egg stored during 21 days.

Key words: *Duck eggs, Physical quality egg, Storage, Vitamin E, Zn organic*

INTRODUCTION

Duck egg production in Indonesia in 2012-2014 were 275.938, 290. 369 and 297.074 tonnes per year, respectively, while egg production of laying hens were 1.139.949, 1.224.402, and 1.299.199 tons per year respectively (BPS 2015).Duck eggs contain 12.81 g of protein and 13.77 g of fat per 100 g egg (USDA 2015).

Eggs are good source of fatty acids, egg yolks contain omega-3 and omega-6 fatty acids as DHA (Docosahexaenoic Acid) and EPA(Docosahexaenoic Acid) derived from feed (Hartono *et al*., 2008). Omega-3 and omega-6 fatty acids have a beneficial effect to prevent cardiovascular disease, cancer, alzheimer and schizophrenia (Simopoulos 2002). Unsaturated fatty acids susceptible to damage due to oxidation process during storage. Therefore, omega-3 and omega-6 fatty acids in duck eggs need to be protected by the addition of antioxidants in the diets. Antioxidants in biological systems has a role in counteracting free radicals that can resist oxidative damage, while antioxidants in the food system has a role for inhibiting the fat oxidation (Hartanto 2012).

Vitamin E and Zn can be added to ducks dietas natural antioxidants that can be metabolized and transferred into the egg.Vitamin E is fat soluble and as antioxidants has a role for breaking the chain of peroxide in membranes and protecting PUFAS (Poly Unsaturated Fatty Acids) from oxidation (Iswara 2009). Rink and Kirchner (2000) states that Zn act as antioxidants and protect the cells from the effects of oxidative damage. The objective of this study was to evaluate the effect of

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Haugh unit was obtained by calculating in the logarithm of the high of albumenand then transformed into a correction value of the function of egg weight (Wahju 1997).

$$HU = Log\ 100\ (H + 7.57 - 1.7.\ W^{0.37)}$$

Description:H = high of albumen; W = eggs weight

Data Analysis

The data were analyzed by analysis of variance. if there was a difference between treatments, the data were further analysed using Duncan's multiple range test according to Steel and Torrie (1993).

RESULTS AND DISCUSSION

Egg weights

Addition of vitamin E, organic Zn and storage of eggs at 5ºC decreased eggs weight significantly ($P < 0.05$). The effect of treatments on egg weight of ducks is presented in Table 2.

Table 2. Effect of treatment on egg weight

Treatments	Egg weight (g/egg)
R1D0	66.56 ± 1.95^{abc}
R2D0	73.74 ± 3.27^{a}
R3D0	68.34 ± 5.22^{abc}
R4D0	63.88 ± 2.04^{bc}
R5D0	69.93 ± 4.22^{ab}
R1T1D21	64.28 ± 4.85^{bc}
R2T1D21	65.42 ± 2.28^{abc}
R3T1D21	63.31 ± 5.22^{bc}
R4T1D21	54.73 ± 4.40^{d}
R5T1D21	64.62 ± 1.78^{abc}
R1T2D21	62.87 ± 5.15^{bcd}
R2T2D21	67.40 ± 0.80^{abc}
R3T2D21	60.13 ± 3.71^{cd}
R4T2D21	64.73 ± 10.01^{abc}
R5T2D21	64.97 ± 7.12^{abc}

Notes: mean in the same column with different superscripts differ significantly ($P < 0.05$)

R1D0 (diet without vitamin E and Organic Zinc and storage), R2D0 (R1+ 40 IU vitamun E, without storage), R3D0 (R1+ 80 IU vitamun E, without storage), R4D0 (R1+ 100 ppm Zn organic, without storage), R5D0 (R1+ 200 ppm Zn organic, without storage), R1T1D21 (R1+ storage of 21 days at a temperature of 29.29 -30.07 ° C), R2T1D21 (R1+ 40 IU vitamun E, Storage 21 days at a temperature of 29.29 -30.07 ° C),R3T1D21(R1+ 80 IU vitamun E, storage of 21 days at a temperature of 29.29 -30.07 ° C), R4T1D21 (R1+ 100 ppm Zn organic, Storage 21 days at a temperature of 29.29 -30.07 ° C), R5T1D21(R1+ 200 ppm Zn organic, Storage 21 days at a temperature of 29.29 ° -30.07 ° C), R1T2D21 (R1+storage of 21 days at a temperature of 5ºC), R2T2D21 (R1 + 40 IU vitamun E, Storage 21 days at a temperature of 5ºC), R3T2D21 (R1+ 80 IU vitamun E, storage of 21 days at a temperature of 5ºC), R4T2D21 (R1+ 100 ppm Zn organic, Storage 21 days at a temperature of 5ºC), R5T2D21 (R1+ 200 ppm Zn organic, 21 days storage at 5ºC temperature)

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The average of eggs weight without storage wasrange from 63.88-73.74 g/egg. Storage of eggs for 21 days decreased eggs weight. Chukwuka *et al*. (2011) stated that the eggs quality was influenced by the management of housing and feeding, egg storage time and temperature.

Addition of 40 IU vitamin E in the diet without storage treatmentresulted heavier eggs than the control diet (R1D0). The results showed that egg weight decreased after 21 days of storage both at refrigerator temperature and at room temperature. Egg storage at room temperature (29.29-30.07 ^{0}C) for 21 days decreased egg weight as much as 8.79%. Supplementation of 100 ppm Zn was not able to sustain the eggs weight stored during 21 days at room temperature (29.29 - 30.07 ^{0}C). According to Raji *et al*. (2009) that the storage for 28 days at the temperature of 32 ^{0}C and 5 ^{0}C decreased egg weight as much as 13.33% and 6.10%. The eggs stored at 30°C for 20 days would loss exosamine and hexose of ovomucin by approximately 50% and decrease sialic acid by 12% (Stadelman and Cotterill 1995). EFSA Panel on Biological Hazards (2014) stated that the the eggs weight reduced during storage due to loss of water vapor and carbon dioxide through pores of egg shell.

Eggshell Weights

Addition of vitamin E, organic Zn and eggs storage at 5^{0}C and room temperature (29.29 -30.07 ^{0}C) did not affect the percentage of eggshell weight. The effect of treatments onshell weight and shell weight percentages was presented in Table 3.

Table 3. The effect of treatment of shell weight and shell weight percentages

Treatment	Eggshell weights (g)	Eggshell weight percentage (%)
R1D0	8.69 ± 0.54	13.05 ± 0.85
R2D0	8.74 ± 0.70	11.85 ± 0.86
R3D0	8:20 ± 0.23	12.03 ± 0.75
R4D0	8.33 ± 0.30	13.05 ± 0.88
R5D0	8.26 ± 0.39	11.82 ± 0.24
R1T1D21	7.62 ± 0.28	11.88 ± 0.70
R2T1D21	7.95 ± 0.35	12.15 ± 0.11
R3T1D21	7:20 ± 0.59	11.37 ± 0.00
R4T1D21	6.90 ± 1.13	12.66 ± 2.33
R5T1D21	7.60 ± 0.40	11.77 ± 0.82
R1T2D21	8.18 ± 0.54	13.03 ± 0.28
R2T2D21	8.30 ± 0.36	12.31 ± 0.44
R3T2D21	7.77 ± 0.84	12.92 ± 1.24
R4T2D21	7.53 ± 0.72	11.72 ± 0.76
R5T2D21	8.00 ± 0.95	12.40 ± 1.76

According to Namra *et al*. (2009), the decreasing of eggshell weight percentage can be due toantagonist interaction between Zn and Ca when given in high amounts. The addition of 200 ppm organic Zn in the diet in this study did not inhibit Ca metabolism and it was suported by previous study that the addition of 200 ppm organic Zn did not decrease the precentage og egg shell weight (Darmawan 2013). Standart of egg shell weight percentage is 12.0% (Suprijatna et al. 2005). The

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percentage of egg shell weight stored at 5 °C was 11.72% -13.03%, while the percentage of egg shell weight stored at room temperature was 11.37% - 12.66%). Idowu *et al*. (2011) stated that the addition of various types of Zn could improve egg weight, shell thickness, shell weight and Haugh units.

Albumen Weight

Addition of vitamin E, organic Zn and eggs storage at 5ºC and room temperature (29.29 -30.07°C) decreased the percentage of albumen weight significantly (P<0.05). Effect of treatmentsof albumen and albumen weight percentages is presented in Table 4.

Albumen weight without storage treatments was34.41-37.06 g. According to Budiman and Rukmiasih (2007), the albumen weight was 33.96 ± 3.94 g, while according Nugraha *et al*. (2013) albumen weights ranged from 36.90-37.56 g. The addition of 100 ppm of organic Zn resulted the largest albumen weight pesentageby 55.34%. Idowu *et al*. (2011) stated that the addition of 35 ppm Zn in the dietled to a decrease in the percentage of albumen weight than the control. Darmawan (2013) stated that addition of 200 ppm Zn in the diet produced albumen weight of 30.37 g (56.65%) - 32.32 g (55.88%).

Table 4. Effect of treatments of albumen and albumen weight percentage

Treatments	Albumen weight (g)	The percentage of Albumen (%)
R1D0	34.41 ± 2:24	51.65 ± 2.25^{abcd}
R2D0	36.94 ± 3.63	50.02 ± 2.84^{abcde}
R3D0	37.04 ± 0.81	54.35 ± 3.05^{ab}
R4D0	35.38 ± 2.71	55.34 ± 2.81^{a}
R5D0	37.06 ± 2.78	52.97 ± 1.08^{abc}
R1T1D21	28.27 ± 3.80	43.85 ± 2.66^{de}
R2T1D21	21.95 ± 0.95	33.61 ± 2.62^{f}
R3T1D21	29.40 ± 2:43	46.44 ± 0.00^{bcde}
R4T1D21	28.03 ± 4:11	51.53 ± 9.65^{abcd}
R5T1D21	27.20 ± 0.60	39.61 ± 1.97^{e}
R1T2D21	31.08 ± 3:22	49.40 ± 1.77^{abcde}
R2T2D21	30.33 ± 2:58	45.04 ± 4.36^{cde}
R3T2D21	28.07 ± 3.62	46.76 ± 6.57^{bcde}
R4T2D21	29.83 ± 8.62	45.60 ± 7.79^{cde}
R5T2D21	31.60 ± 3:58	48.66 ± 2.38^{abcde}

Notes: mean in the same column with different superscripts differ significantly (P <0.05)

The addition of 40 IU vitamin E and 200 ppm Zn has not been able to maintain (P >0.05) the albumen weight percentage stored for 21 days at room temperature. Raji *et al*. (2009) stated, that declining of albumen weight was caused by the increasing of storage temperature. The Storage leads to loss of $CO_2$and water in albumen through eggshell pores and change the carbonic acid into carbon dioxide (Raji et al. 2009). Stadelman and Cotterill (1995) stated that the component of albumen was water ,protein and ash which was 88%,10,6% and 0,6% respectively.

Yolk Weight

Addition of vitamin E, organic Zn and eggs storage at 5ºC and room temperature (29.29 -30.07°C) increased the percentage of yolk weight significantly (P<0.05). Effect

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of the treatments of yolk weight and egg yolk weight percentage can be seen in Table 5.

Addition of 40 IU Vitamin E without storage resulted the largest percentage of yolk weight by 28.06 g (38.13 ± 3.14%), while the addition of 100 ppm Zn organic caused a smaller percentage of yolk weight (31.61 ± 2.45%) than the control. Suprijatna *et al*. (2005) stated that the percentage of the yolk weight was 35.4%. Bell and Weaver (2002) stated that the percentage of yolk weight was around 30% -32% of the egg weight. The addition of 30 ppm vitaminE and 0.15 ppm selenium in the diet could increase the yolk weight as much as 0.7% (Zduńczyk et al. 2013).

The yolk percentage of this study increased both of storage at room temperature and 5 ° C. The suplementation of 40 IU vitamin E and 200 ppm organic Zn with storage treatment for 21 days at room temperature caused the increasing of yolk weight. The increasing of yolk weight can be caused by the movement of water from the albumen into the yolk. According to Stadelman and Cotterill (1995) , water move from the albumen into the yolk during storage of eggs that will reduce the solid concentration in yolk. Rose et al. (1966) stated that solid concentration in the yolk (52.39%) stored at 4 ° C for one week decreased to 50.09%. Fromm (1966) in his research stated that the eggs stored at 24 ° C for 16 days led to decrease the yolk solid concentration of 53.5% to 49%. In addition, the increasing of yolk weight percentage can be caused by decreasing of albumen and egg shell weight. The content of the yolk was dominated by lipids (31.8% -35.5%) and protein (15.7% -16.6%), while the composition of inorganic elements in yolk was about 1.1% as ash (Stadelman and Cotterill 1995).

Table 5. Effect of the treatments of egg yolk weight and yolk weight percentage

Treatments	Yolk weight (g)	The yolk percentage (%)
R1D0	23.47 ± 1.80	35.29 ± 2.84^{def}
R2D0	28.06 ± 1.45	38.13 ± 3.14^{cdef}
R3D0	23.10 ± 4.25	33.61 ± 3.78^{ef}
R4D0	20.18 ± 1.44	31.61 ± 2.45^{f}
R5D0	24.61 ± 1.23	35.21 ± 0.85^{def}
R1T1D21	28.40 ± 1.14	44.27 ± 1.96^{bc}
R2T1D21	35.52 ± 2.88	54.23 ± 2.51^{a}
R3T1D21	26.71 ± 2.20	42.19 ± 0.00^{bcde}
R4T1D21	19.80 ± 7.23	35.82 ± 11.94^{cdef}
R5T1D21	30.70 ± 1.90	47.51 ± 2.54^{ab}
R1T2D21	23.60 ± 1.92	37.57 ± 1.86^{cdef}
R2T2D21	28.77 ± 3.16	42.65 ± 4.21^{bcd}
R3T2D21	24.30 ± 4.04	40.32 ± 5.45^{bcdef}
R4T2D21	27.37 ± 4.80	42.68 ± 7.37^{bcd}
R5T2D21	25.37 ± 4.57	38.94 ± 3.97^{bcdef}

Notes: mean in the same column with different superscripts differ significantly (P <0.05)

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Haugh Unit

Addition of vitamin E, organic Zn and eggs storage at 5ºC and room temperature (29.29 -30.07°C) decreased the value of Haugh units significantly ($P<0.05$). Effect of the treatments of the Haugh unitis presented in Table 6.

The results showed that suplementation of 200 ppm organic Zinc without storage resulted the highest Haugh unit value. According to Stadelman and Cotteril 1995, egg quality was divided into several categories, namely AA quality (Haugh unit value more than 72), A quality (Haugh unit value 60-72), and B quality (Haugh unit values less than 60). The Haugh unitvalue of the fresh egg was AA egg quality.

Addition of 200 ppm Zinc decreased as much as 7.78% Haugh unit value after being stored for 21 days at temperature of 5°C. Zduńczykv *et al.* (2013) stated that the addition of vitamin 30 ppm E increased the Haugh unit value of 5. 02%, while Idowu *et al.* (2011) stated that the addition of 35 ppm Zincincreased the Haugh unit until 4.59%. The higher Haugh unit value showed the greater the quality of albumen protein (Stadelman and Cotterill 1995). Ovomucin was a type of protein found in albumen that contribute to make the structure of albumen.

Table 6. Effect of treatments of the Haugh unit value

Treatment	Haugh Unit
R1D0	91.21 ± 6.49^{ab}
R2D0	91.79 ± 1.96^{ab}
R3D0	93.52 ± 4.60^{a}
R4D0	91.14 ± 3.79^{abc}
R5D0	93.56 ± 3.49^{a}
R1T1D21	68.61 ± 6.28^{ef}
R2T1D21	48.06 ± 14.52^{g}
R3T1D21	69.48 ± 2.11^{abc}
R4T1D21	64.42 ± 2.12^{f}
R5T1D21	51.46 ± 18.93^{g}
R1T2D21	77.38 ± 7.20^{bcde}
R2T2D21	70.43 ± 8.46^{def}
R3T2D21	84.74 ± 6.44^{abcd}
R4T2D21	75.09 ± 1.83^{cdef}
R5T2D21	86.28 ± 5.48^{abc}

Notes: mean in the same column with different superscripts differ significantly ($P<0.05$)

Yolk Colour Scores

Addition of vitamin E, organic Zn and eggs storage at 5ºC and room temperature (29.29 -30.07°C) decreased the yolk colour scoressignificantly ($P<0.05$). Effect of treatment of yolk color scores is presented in Table 7. The results showed that the suplementation of Zn and vitamin E with 46% yellow corn in the dietsresulted the yolk color score of 6.61-7.89. The feed Xanthophylls in the diets will lead the colour of orange or red yolk (Castaneda et al. 2005). Yellow corns contain xanthophylls about 17 mg/ kg (Moros et al. 2002).Eggs stored at 5 ° C for 21 days had lower yolk scores than the those at room temperature. The suplementation of 80 IU vitamin E without storage resulted in low yolk scores, but it could maintain yolk colour score after being stored for 21 days at 5°C as well as at room temperature.

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Table 7. Effect of treatments of yolk color scores

Treatment	yolk colorscores
R1D0	7.72 ± 0.67^{a}
R2D0	7.61 ± 0.10^{a}
R3D0	6.61 ± 2.26^{ab}
R4D0	7.89 ± 0.38^{a}
R5D0	7.56 ± 0.63^{a}
R1T1D21	2.83 ± 1.04^{cd}
R2T1D21	1.75 ± 0.25^{d}
R3T1D21	6.50 ± 0.00^{ab}
R4T1D21	3.17 ± 0.58^{cd}
R5T1D21	3.50 ± 0.00^{c}
R1T2D21	7.50 ± 0.50^{a}
R2T2D21	7.67 ± 0.58^{a}
R3T2D21	5.33 ± 1.15^{b}
R4T2D21	5.67 ± 1.53^{b}
R5T2D21	6.67 ± 0.58^{ab}

Notes: mean in the same column with different superscripts differ significantly ($P < 0.05$)

The yolk color scores that resulted byaddition of 100 ppm and 200 ppm Zinc in the diet was not different from the control. The decreasing of yolk color score after a 21-day storage can be due todeclining of yolk fat quality due to oxidation process. The storage of eggs caused the displacement of water from the albumen into the yolk and reduced lysozime content and rupturedthe vitelin membranes (Bieber et al. 2015). Yolk color scores was affected by the chemical structure of thexanthophylls, antioxidants and fat content in the feed (Stadelman and Cotterill 1995).

Eggshell Thickness

Addition of vitamin E, organic Zn and eggs storage at 5ºC and room temperature (29.29 -30.07°C) decreased the eggshell thickness significantly ($P<0.05$). Effect of treatments of eggshell thicknessis presented in Table 8.

Addition of 40 IU resulted the largest eggshell thickness (0.38 mm ± 0.02). The eggshell thickness that resulted by suplementation of 200 ppm organic Zinc was not differ from the control, it was consistent with the study of Darmawan (2013) that the addition of 200 ppm organic Zinc did not interfere the calcium metabolism. The supplement of 100 ppm Zn organic with the storage treatment during 21 days at room temperature reduced the eggshell thickness. Zinc has important role in the formation of egg shell and membrane cell, because Zn was a cofactor of enzyme for the formation of eggshell carbonate (Idowu et al. 2011). The results showed that the longer the eggs stored would reduce eggshell thickness because of carbonate ions evaporation during storage. Eggshell contains calcium carbonate (94%) , magnesium carbonate (1%), calcium phosphate (1%), and organic materials such as proteins (4%) (Stadelman and Cotterill 1995).

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Table 8. Effect of treatments of eggshell thickness (mm)

Treatments	Eggshell thickness (mm)
R1D0	0.36 ± 0.03^{ab}
R2D0	0.39 ± 0.02^{a}
R3D0	0.39 ± 0.00^{a}
R4D0	0.37 ± 0.05^{ab}
R5D0	0.37 ± 0.02^{ab}
R1T1D21	0.36 ± 0.01^{ab}
R2T1D21	0.35 ± 0.00^{abc}
R3T1D21	0.35 ± 0.00^{abc}
R4T1D21	0.30 ± 0.05^{c}
R5T1D21	0.35 ± 0.02^{abc}
R1T2D21	0.35 ± 0.05^{abc}
R2T2D21	0.39 ± 0.01^{a}
R3T2D21	0.36 ± 0.03^{ab}
R4T2D21	0.34 ± 0.03^{abc}
R5T2D21	0.33 ± 0.03^{bc}

Notes: mean in the same column with different superscripts differ significantly ($P < 0.05$)

CONCLUSION

Adiition of 200 ppmZn or80 IU vitamin E in the diet could maintain the quality of duck egg stored during 21 days.

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