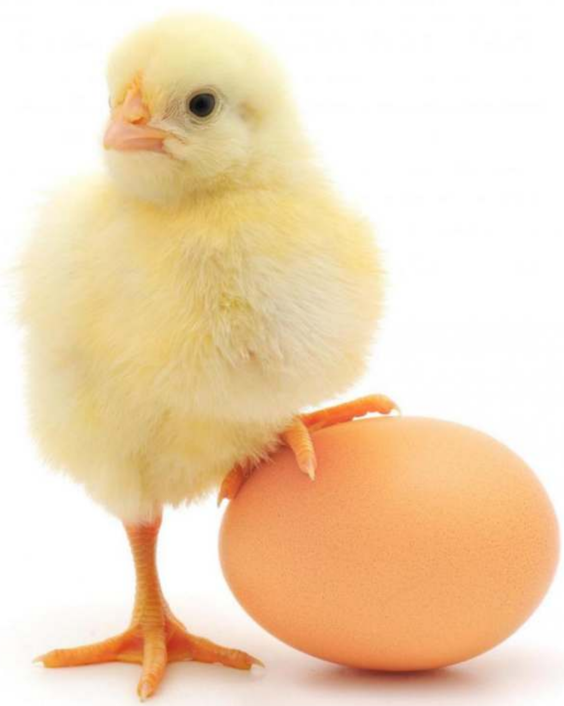
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 14 (12): 628-632, 2015
ISSN 1682-8356

Production Performance of Gold Arab Laying-Hens Fed Diet Containing *Neurospora crassa* Fermented Palm Kernel Cake

Yose Rizal, Nuraini, Mirnawati, Maria Endo Mahata, Rio Darman and Dendi Kurniawan
Faculty of Animal Sciences, University of Andalas, Padang, West Sumatra, Indonesia

Abstract: An experiment was conducted to determine the effects of several levels of Neurospora crassa-fermented palm kernel cake in the diet on the production performance of Gold Arab laying-hens and to obtain the appropriate level of this fermented palm kernel cake for reducing the utilization of concentrated feed in the diet. Three hundred Gold Arab laying-hens of 72 weeks old were employed in this experiment and randomly assigned to four treatments (0, 7.25, 10.15 and 13.05% fermented palm kernel cake in diets) in a completely randomized design with five replicates. The measured variable was production performance (feed consumption, egg-mass production, feed conversion, egg weight and hen-day egg production). Results of experiment indicated that feed consumption, egg-mass production, feed conversion, egg weight and hen-day egg production were not influenced ($p>0.05$) by diets. In conclusion, Neurospora crassa-fermented palm kernel cake could be included up to 13.05% to effectively replace 45% concentrated feed in the diet of Gold Arab laying-hens without adverse effect on the production performance.

Key words: Neurospora crassa, fermentation, palm kernel cake, Gold Arab laying-hens, production performance

INTRODUCTION

Palm oil plant (Elaeis guineensis Jacq.) is originated from West Africa (Cheng Hai, 2011). According to BPS (2010) Indonesia is the biggest producer of crude palm oil in the world with the total production of 22.5 million tonnes per year in which 70% of the total production of crude palm oil is located in Sumatra Island. Based on this development of palm oil plantation, Indonesia will produce a huge amount of waste or by-product of palm oil industry in the form of palm kernel cake (PKC) in the future because 45-46% of the by-product of palm oil industry is PKC.

Mustaffa *et al*. (1987) and Chin (1991) reported that the nutrient contents of PKC were as follows: crude protein 14.6-16.0%, crude fiber 12.1-16.8%, ether extract 0.9-10.6%, Ca 0.20-0.25% and P 0.32-0.54%. The variation of these nutrient contents is influenced by the way of extracting oil from the palm kernels. Rizal (2000) revealed that the nutrient contents of PKC were: crude protein 18.63%, crude fiber 12.29%, ether extract 10.57%, Ca 0.47 and P 0.27. Sundu *et al*. (2006) found crude protein 14-21%, crude fiber 21-23% and lipid 8-17%. Meanwhile, Mirnawati *et al*. (2008) found that the nutrient contents of PKC were as follows: crude protein 16.07%, crude fiber 21.30%, ether extract 8.23%, Ca 0.27%, P 0.94% and Cu 48.4 ppm, so that it can be utilized as an animal feed. Eventhough its crude protein content was rather high, its utilization in poultry diets was not optimal yet. Palm kernel cake could be included up to 10% in the duck ration (Supriyadi, 1997) and according to Rizal (2000) PKC could be utilized up to 10% in the broiler diet to effectively replace 40% soybean meal.

According to Rizal *et al*. (2013) the low in the utilization of PKC in poultry diets was due to the low in the nutritive value of this PKC. The low in nutritive value of PKC was related to the high in crude fiber content, low amino acids content and high in Cu content (Nwokolo *et al*., 1976; Ezhiesshi and Olomu, 2004; Mirnawati *et al*., 2008) and high in β-mannan or mannose polymere (Dusterhoft *et al*., 1993; Tafsin *et al*., 2007). In addition, Scott *et al*. (1982) and Sundu and Dingle (2003) stated that the ability of poultry to digest crude fiber is limited. Palm kernel cake has high content of beta-mannan, cellulose and galactan (Sundu and Dingle, 2003).

The processing of PKC through fermentation had been performed to increase its utilization in poultry diets. For example, fermentation by using cellulolitic microbes such as: Trichoderma harzianum, *Penicillium* sp., Aspergillus niger and Aspergillus niger+humic acid (Sabrina *et al*., 2001; Nuraini and Yunara, 2001; Aziz *et al*., 2003; Harnentis *et al*., 2005; Mirnawati *et al*., 2008; Mirnawati *et al*., 2010; Rizal *et al*., 2013), proteolitik such as: *Rhizopus* sp. (Sabrina *et al*., 2001) and carotenogenic such as: *Neurosphora* sp. (Sabrina *et al*., 2001) and Neurospora crassa (Nuraini and Susilawati, 2006; Rizal *et al*., 2013). Fermentation of PKC with Aspergillus wentii TISTR 3075 increased its crude protein from 16.99 to 21.36% (Muangkeow and Chinajariyawong, 2013) and fermentation with

Corresponding Author: Yose Rizal, Faculty of Animal Sciences, University of Andalas, Padang, West Sumatra, Indonesia

Aspergillus niger increased crude protein from 17.5 to 24.7% (Marini *et al*., 2008). Meanwhile, Rizal *et al*. (2013) reported a slightly increase in crude protein from 23.30 to 24.49%, whereas a decrease in crude fiber from 18.86 to 14.75% in PKC fermented with Neurospora crassa. Poultry response to the utilization of fermented-PKC (PKC-F) was still variably, ranging from 15 to 25% (Sabrina *et al*., 2001; Nuraini and Trisna, 2006; Nuraini *et al*., 2007).

The practical diet formulation for laying-hens in West Sumatra and some other places in Indonesia mostly consists of yellow corn, rice bran and concentrated feed. This concentrated feed is formulated by several companies as one of feed ingredients in laying-hens diets. The ability of Neurospora crassa-fermented palm kernel cake (PKC-F) to replace concentrated feed in the diet of Gold Arab laying-hens has not yet been performed.

MATERIALS AND METHODS

Purposes of the experiment: The purposes of this experiment were to study the effect of several levels of Neurospora crassa-fermented palm kernel cake in the diet on the production performance (feed consumption, egg-mass production, feed conversion, egg weight and hen-day egg production) of Gold Arab laying-hens and to obtain the appropriate level of this fermented palm kernel cake (PKC-F) for reducing the utilization of concentrated feed in the diet.

Experimental animals and diet composition: Three hundred 72 weeks old Gold Arab laying-hens were assigned to this experiment. The experiment was performed in a completely randomized design (CRD) with four treatments (0, 7.25, 10.15 and 13.05% PKC-F in diets) and five replicates. There were 15 Gold Arab laying-hens per unit of experiment. This laying-hen was kept in individual cage (40 x 40 x 30 cm) without additional light during the night. Formulation, nutrient and metabolizable energy contents of treatment diets were figured in Table 1. Diet formulation consists of yellow corn, rice bran, fish meal, bone meal, concentrated feed and PKC-F. The concentrated feed contained crude protein 32.46%, crude fiber 10.85%, ether extract 4.87%, Ca 12.8% and P 1.23%. Fermented-palm kernel cake was the product of 80% PKC plus 20% rice bran that was fermented with Neurospora crassa. Diet and drinking water were provided *ad-libitum*.

Table 1: Formulation and nutrient and metabolizable energy contents of diets

	---------------------- Diet formulation		----------------------
Ingredients	A	B	C	D
Yellow corn	42.00	42.00	42.00	42.00
Rice bran	29.00	26.00	25.00	24.00
Fish meal	-	2.00	2.50	3.00
Bone meal	-	1.00	1.50	2.00
Concentrated feed	29.00	21.75	18.85	15.95
PKC-F	-	7.25	10.15	13.05
Total	100	100	100	100
Nutrient and energy contents				
Crude protein (%)	16.92	16.93	16.82	16.70
Ether extract (%)	3.71	3.49	3.41	3.32
Crude fiber (%)	8.46	8.40	8.39	8.38
Ca (%)	4.08	3.46	3.22	2.99
P (%)	0.51	0.58	0.62	0.66
ME (Kkal/kg)	2644	2640	2626	2612

Data collection: Collected data were feed consumption (g/head/day), the percentage of hen-day egg production, egg weight (g/egg), egg-mass production (g/head/day) and feed conversion ratio.

Data analyses: All of the data were analyzed by analysis of variance of a completely randomized design according to Steel and Torrie (1980). Duncan Multiple Range Test (DMRT) was performed for testing the difference among treatments (Steel and Torrie, 1980).

RESULTS

The effects of treatments on the production performance (feed consumption, hen-day egg production, egg weight, egg mass production and feed conversion) of Arab laying-hens were illustrated in Table 2.

Feed consumption: The feed consumption of Gold Arabic laying-hens was not affected ($p>0.05$) by the levels of PKC-F in the diets. The increase in the level of PKC-F in the diets did not reduce the feed consumption of the Gold Arabic laying-hens. The feed consumption was ranging from 78.95 to 79.58 g/head/day.

Hen-day egg production: The levels of PKC-F in the diets did not influence ($p>0.05$) the hen-day egg production of Gold Arabic laying-hens. The increase in the levels of PKC-F in the diets maintained this hen-day egg production. The hen-day egg production of this experiment was ranging from 42.13 to 50.93%.

Egg weight: The egg weight of Gold Arabic laying-hens was not effected ($p>0.05$) by the levels of PKC-F in the diets. The increase in the level of PKC-F in the diets did not affect the egg weight of Gold Arabic chicken. The egg weight of Gold Arabic laying-hens in this experiment was ranging from 45.55 to 46.69 g/egg.

Egg mass production: The egg mass production of Gold Arabic laying-hens were not affected ($p>0.05$) by the levels of PKC-F in the diets. The increase in the levels of PKC-F in the diets did not influence the egg mass production of Gold Arabic laying-hens. The egg mass production of Gold Arabic laying-hens in this experiment was ranging from 19.70 to 22.76 g/head/day.

Feed conversion: The feed conversion ratio of Gold Arabic laying-hens were not affected ($p>0.05$) by the

Table 2: Means of feed consumption, hen-day egg production, egg weight, Egg mass production and feed conversion^{ns}

	Measured variables				
Treatments	Feed consumption (g/head/day)	Hen-day egg production (%)	Egg weight (g/egg)	Egg mass production (g/head/day)	Feed conversion
A	78.95	42.13	46.69	19.70	4.10
B	79.18	50.93	45.55	22.76	3.48
C	79.58	48.33	45.79	22.08	3.75
D	79.21	47.40	45.68	21.21	3.79
SE*	0.26	3.50	0.38	1.54	0.19

^{ns}Non-significant (p>0.05). *Standard error of the mean

levels of PKC-F in the diets. Eventhough the level of PKC-F was increased, the feed conversion was not influenced. The feed conversion of Gold Arabic laying-hens in this experiment was ranging from 3.48 to 4.10.

DISCUSSION

The feed consumption in this experiment was similar to the result of experiment by Safingi *et al*. (2013) who obtained the feed consumption of Arabic chicken was ranging from 78.31 to 79.14 g/head/day when supplemented with different probiotics in the diet. This result was also inaccordance with the result of experiment by Alwi (2014) who obtained that the feed consumption of Arabic chicken was ranging from 77.38 to 84.88 g/head/day. This result was lower than the result of experiment by Lestari (2005) who previously found that the feed consumption of Arabic chicken was ranging from 81.94 to 87.46 g/head/day when fed 0 to 15% of sludge of alcohol industry with the highest at 3% level in the diet. Argo *et al*. (2013b) obtained higher feed consumption of Arabic chickens (94.87 to 98.36 g/head/day) when compared with the result of this experiment.

The hen-day egg production in this experiment was almost similar to the result of experiment by Alwi (2014) who obtained that the hen-day egg production of Arabic chicken was ranging from 40.28 to 58.33%. The hen-day egg production of Arabic chicken that was obtained by Argo *et al*. (2013b) was higher than that of this experiment. However, the hen-day egg production of this experiment was higher than that of the experiment by Istinganah *et al*. (2013) who found that the hen-day egg production of Arabic chickens was ranging from 31.95 to 35.87% when fed different probiotics.

The egg weight average of Gold Arabic laying-hens in this experiment was similar to the experiment by Yumna *et al*. (2013) who found that the egg weight average of Gold Arabic laying-hens was 46.81 g/egg and almost similar to the result obtained by Santoso and Suharyanto (2011) in which the egg weight of Arabic chickens was ranging from 44.9 to 43.7 g/egg when supplemented with Sauropus androgynous extract in the diets. However, it was slightly higher than the results of experiment by Argo *et al*. (2013a) who found that the egg weight of Arabic chicken was ranging from 40.71 to 43.97 g/egg when supplemented with 0 to 9% Azolla microphylla in the diet and by Diwyanto and Prijono (2007) who found that the average egg weight of Arabic chicken was 42.5 g/egg. Istinganah *et al*. (2013) obtained that the egg weight of Arabic chickens fed with different probiotics was higher than the result of this experiment. Meanwhile, Lestari (2005) found the lower egg weight (32.07 to 33.57 g/egg) when Arabic chickens were fed with sludge of alcohol industry in the diet.

The egg mass production average of Gold Arabic laying-hens in this experiment was almost similar to the result of experiment by Santoso and Suharyanto (2011) who found that the egg mass production of Arabic chicken layers was ranging from 22.05 to 29.66 g/head/day. However, this result was higher than the result of experiment by Lestari (2005) who obtained the Arabic chicken's egg mass production from 12.46 to 15.90 g/head/day when supplemented with sludge of alcohol industry from 0 to 15% with the highest egg mass production at 3% level. Argo *et al*. (2013b) obtained higher egg mass production of Arabic chickens (17.95 to 32.62 g/head/day) when it was compared with the result of this experiment.

The average of feed conversion of Gold Arabic laying-hens in this experiment was similar to the feed conversion obtained by Santoso and Suharyanto (2011), which was ranging from 3.03 to 4.08 when Arabic chickens were fed with diets containing Sauropus androgynous extract at different levels. However, this feed conversion was slightly higher than the result of experiment by Alwi (2014) who obtained that the feed conversion of Arabic chicken was ranging from 2.76 to 3.73. However, it was better than the result of experiment by Lestari (2005) who obtained 4.99 to 5.09 feed conversion of Arabic chicken fed sludge of alcohol industry in the diet. Argo *et al*. (2013b) found that the feed conversion of Arabic chickens was varied from 3.05 to 5.42.

Based on the results of this experiment, it was found that Neurospora crassa-fermented palm kernel cake could be included up to 13.05% in Gold Arabic laying-hens diet without adverse effect on their production performance.

Conclusion: The increase in the level of PKC-F utilization in Gold Arabic laying-hens diet did not affect their production performance. The PKC-F could be included up to 13.05% in the diet of Gold Arabic laying-hens to effectively replace 45% concentrated feed.

ACKNOWLEDGEMENT

This experiment was supported by the MP3EI Funding Program provided by the Directorate General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia. I am very grateful to the Dean of the Faculty of Animal Science and the Rector of the University of Andalas who have given me a chance to compete with others in obtaining this funding. My special thanks was also directed to the Director General of Higher Education and the Minister of Education and Culture who have provided the funding.

REFERENCES

Alwi, W., 2014. The Effects of Energy-Protein Balance on Arabic Chicken's Performance. Skripsi. Fakultas Peternakan, UniversitasHasanuddin, Makassar.

Argo, L.B., Tristiarti and I. Mangisah, 2013a. Physical quality of Arabic chicken's eggs supplemented with several levels of Azolla microphylla. Anim. Agric. J., 2: 445-457.

Argo, D.B., I.H. Djunaidi and M.H. Natsir, 2013b. Effects of bananas peel meal addition as corn substitution on production performance of Arabic chicken (Gallus turcicus). http://fapet.ub.ac.id/wp-content/uploads/2014/06/.

Aziz, A., S. Gan, S.H. Hasan, M.A. Karim and S. Noraini, 2003. Biomass Estimation and Growth of Aspergillus niger in solid state fermentation on Palm Kernel Cake in: Proceedings of 14th National Biotechnology Seminar, Desember 11-13 Penang, Malaysia, pp: 59.

BPS, 2010. Indonesian Statistics. Center Bureau of Statistics, Jakarta.

Cheng Hai, T., 2011. The palm oil industry in Malaysia: from seed to frying pan. Prepared for WWF Switzerland by TEOH Cheng Hai, Hon. Advisor, Plantation Agriculture, WWF.

Chin, F.Y., 1991. Oil palm-A rich source of animal feed. In: Asian livestock. PHCA Public. Bangkok, Thailand.

Diwyanto, K. and S.N. Prijono, 2007. Biodiversity of local chickens in Indonesia. Pusat Penelitian Biologi, Lembaga Ilmu Pengetahuan Indonesia, Jakarta.

Dusterhoft, E.M., A.W. Bonte and A.G.J. Voragen, 1993. Solubilisation of non-starch polysaccharides from oil seed meals by polysacharide degrading enzymes. J. Sci. Food and Agric., 63: 211-220.

Ezhiesshi, E.V. and J.M. Olomu, 2004. Nutritional evaluation of palm kernel meal types: 2. Effects on live performance and nutrient retention in broiler chicks diets. Afr. J. Biotechnol., 7: 1171-1175.

Harnentis, Mirnawati and Mirzah, 2005. Palm kernel cake processing technology for increasing its utility in poultry diets. Competitive Grant Research Report XIII. Ministry of Education and Culture, Indonesia.

Istinganah, L., S. Mugiyono and N. Iriyanti, 2013. The effect of using variety of probiotics in Arabian chicken diets on egg production and egg weight. J. Ilmiah Peternakan, 1: 338-346.

Lestari, P.T., 2005. Eggs production of Arabic chicken fed sludge of alcohol industry in the diet. http://eprints.undip.ac.id/4233/1/6.pdf.

Marini, A.M., M.Y. Ayub, B.A. Salam, H. Hadijah, E.A.E. Azahan and S.A. Tarmizi, 2008. Protein quality of Aspergillus niger-fermented palm kernel cake. J. Trop. Agric. and Fd. Sci., 36.

Mirnawati, I., Putu Kompiang and Harnentis, 2008. The role of humic acid as heavy metal scavenger in processing palm kernel cake for poultry feed. Competitive Grant Research Report. Ministry of Education and Culture, Indonesia.

Mirnawati, Y. Rizal, I.P. Kompiang and Y. Marlida, 2010. The role of humic acid in palm kernel cake fermented by Aspergillus niger for poultry ration. Pak. J. Nutr., 9: 182-185.

Muangkeow, N. and C. Chinajariyawong, 2013. Determination of true amino acid digestibility and metabolizable energy in fermented palm kernel meal with Aspergillus wentii TISTR 3075 for chickens. Walailak J. Sci. and Technol., 6: 231-241.

Mustaffa, A.B., F.Y. Chin and S.M. Yusoff, 1987. The use of palm kernel cake as animal feed. Dept. Vet. Services Mimeograph. Bangkok, Thailand as contribution from Mustaffa, A.B.

Nuraini and Susilawati, 2006. The nutrient content of Neurospora crassa-fermented palm kernel cake. Research Report. Faculty of Animal Science andalas University, Padang.

Nuraini and A. Trisna, 2006. The response of broilers on the ration containing *Penicillium* sp. fermented palm kernel cake. Journal Agribisnis Peternakan (Agripet) USU, Medan, 2: 45-48.

Nuraini and Yunara, 2001. Increasing the nutrient quality of palm kernel cake through fermentation by using *Penicillium* sp. Journal Andalas Edisi Pertanian No 36/May/ThXIII.

Nuraini, Siswanti and Widodo, 2007. Production performance and egg quality of hens receiving diets containing Neurospora crassa-fermented palm kernel cake. Journal Agribisnis Peternakan (Agripet) USU, Medan, 2: 55-59.

Nwokolo, E.N., D.B. Bragg and S.S. Saben, 1976. The availability of amino acids from palm kernel, soybean, cotton seed and rape seed meal for the growing chick. Poult. Sci., 55: 2300-2304.

Rizal, Y., 2000. The response of broilers to the substitution part of soybean meal for palm kernel cake in the diet. J. Peternakan dan Lingkungan, 2: 15-20.

Rizal, Y., Nuraini, Mirnawati and M.E. Mahata, 2013. Comparisons of nutrient contents and nutritional values of palm kernel cake fermented by using different fungi. Pak. J. Nutr., 12: 943-948.

Sabrina, Nuraini, M.H. Abbas and R. Zein, 2001. Improving the nutrient quality of palm kernel cake through biotechnological approach by using several fungi. Competitive Grant Research Report. Ministry of Education and Culture, Indonesia.

Safingi, A., M. Mufti and N. Iriyanti, 2013. The use of variation of probiotics in Arabic chicken's diets on feed consumption and income over feed cost. J. Ilmiah Peternakan, 1: 970-975.

Santoso, U. and Suharyanto, 2011. Usage of Sauropus androgynous extract to increase egg production and quality efficiency in Arabic chicken layers. J. Sain Peternakan Indonesia, 6: 41-46.

Scott, M.L., M.C. Nesheim and R.J. Young, 1982. Nutrition of the Chicken. Third Edition. M.L. Scott and Associates, Ithaca, New York.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures Statistics: A Biometrical Approach. McGraw Hill Book Co., New York.

Sundu, B. and J. Dingle, 2003. Use of enzymes to improve the nutritional value of palm kernel meal and copra meal. Proceedings of Quensland Poult. Science Symposium. Australia, 1: 1-15.

Sundu, B., A. Kumar and J. Dingle, 2006. Palm kernel meal in broiler diets: effect on chicken performance and health. World Poult. Sci. J., 62: 316-325.

Supriyadi, 1997. The effect of palm kernel cake utilization in the diet on the physiological organ of growing ducks. Skripsi. Faculty of Animal Science andalas University, Padang.

Tafsin, M., L.A. Sofyan, N. Ramli, K.W. Wiryawan, K. Zarkasie and W.G. Piliang, 2007. Polysaccharide mannan of palm kernel cake anti microbial agent for Samonella thypimurium in the chicken. Media Peternakan-J. Anim. Sci. Bogor Agric. Inst., 30: 139-146.

Yumna, M.H., A. Zakaria and V.M.A. Nurgiartiningsih, 2013. Quantity and quality of Silver and Gold Arabic chicken (Gallus turcicus). J. Ilmu-ilmu Peternakan, 23: 19-24.