IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

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To cite this article: S Hartini *et al* 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **207** 012023

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The effects of rice hull supplementation or inclusion on performance and gastrointestinal weight of broiler chickens

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Abstract. The effects of rice hull inclusion or supplementation on the growth performance and gastrointestinal (GIT) weight of broiler chickens were investigated. Three diets, corn-soybean-based diet as control diet (CON), supplementation of 40 g/kg rice hulls on CON (SRH), inclusion of 40 g/kg rice hulls in the diets (IRH) were used for the experiment. The diets were fed to broiler chickens from 2 to 21 d of age. Each treatment was replicated 10 times (8 birds/ replicate or 80 birds/ treatment). From 14 to 21 d of age and across 2 to 21 d of age, broilers fed the IRH had a greater ($P \leq 0.05$) average daily gain (ADG) than those fed the SRH with birds fed the CON being intermediate. Feed intake (FI) followed a similar trend as ADG. From 14 to 21 d of age, birds fed the IRH had higher ($P \leq 0.05$) FI, followed by the CON, and the SRH as the lowest. Rice hull inclusion increased the intestinal content as a percentage of BW, with an effect similar to that of the CON ($P \leq 0.05$). Birds fed the IRH had a lower ($P \leq 0.05$) weight of empty ceca than those fed the SRH and the CON which were not different. The results indicated that the inclusion or supplementation of rice hull produces different effect on the growth performance and GIT weight of young broilers. Diet composition is suggested to be the factors that caused the differences. The diet composition due to rice hull inclusion affected the growth performance and GIT weight of broiler chicken more than the diet composition due to rice hull supplementation.

1. Introduction

The benefit of rice hulls for broiler performance is rarely to be discussed, in reality the use of rice hulls in poultry production is only popular as broilers litters or beddings. The chemical compositions of rice hulls are crude protein 2.4%, ether extract 0.5%, ash 12.9%, crude fibre 54.2%, total dietary fibre 74 %, insoluble fibre 72%, and soluble fibre 2% [1]. The high contents of crude fibre and insoluble fibre become the constraint on the use of rice hulls in poultry diets. However, after recent studies indicated that inclusion of insoluble fibre could improve i.e. utilization of other nutrients [2], gastrointestinal (GIT) health [3], growth performance [4] of broiler chickens and could reduce cannibalism mortality in laying hens [5], there is a growing interest in using the insoluble fibre sources in poultry diets. Rice hulls as one of insoluble fibre sources get more attention regarding their use in broilers diets. Hartini and Massora [6] showed that broilers could maintain BWG with the addition of 4 % rice hulls same as the control diet, but impaired BWG and FCR with the addition of 6% rice hulls. Sadeghi et al. [7] showed that inclusion of 3% rice hulls in the diets did not affect growth performance, carcass and gizzard weight, but shorten jejunum length and increased ileum weight of broiler at 42 days of age. Inclusion of 2.5% rice hulls in broiler diets has been reported to increase average daily gain dan feed

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to gain ratio better than the control diet [1]. In addition, an increase level of rice hulls from 2.5 to 5% in mash form did not improve ADG and F:G. Hartini and Purwaningsih [8] added 4% rice hulls with phytase in a commercial diet having low Ca and P found no effect on ADG, but an increase in percentage of carcass weight and a decrease in GIT weight.

Each fiber has each own physicochemical properties and its interaction with other component in the diet influence its effect on GIT [9]. Thus, it is hypothesised that the inclusion or supplementation of rice hull in the diet will produce different effects on broiler performance. The current study was designed to investigate the effects of rice hull inclusion or supplementation on growth performance and gastrointestinal weight of young broiler chickens.

2. Materials and Methods

2.1. Experimental diets, animals, and birds management
The diets used in the experiment were: 1) corn-soybean-based diet as a control diet (CON), 2) CON + 40 g/kg rice hulls (SRH), 3) inclusion 40 g/kg rice hulls in the diets (IRH). Rice hulls were ground through a hammer mill (2 mm screen) before being used. Composition and nutrient content of the treatment diets are shown in Table 1.

All diets were formulated isocaloric and isoprotein and met all nutrient recommendations of the NRC [10] for broilers starter. All experimental diets were provided as mash feed and were fed to broiler chickens from 2 to 21 d of age. A total of 240 unsexed broiler chicks (strain Lohman) at two days old (initial body weight of 53.6 ± 1.7 g) were randomly placed in 40 cages with 8 birds per cage and 10 cages (80 birds) per treatment. *Ad libitum* feed and water were provided during the experiment. The cages had continuous light.

2.2. Growth performance
Body weight (BW) and feed intake (FI) were weighed by cage at 2, 7, 14, and 21 d of age. From the data obtained, we determined the average of daily gain (ADG) (g/b/d), daily feed intake (ADFI) (g/b/d), and the average of gain to feed ratio (G:F) (g/g). Birds that died during the experiment were weighed and their remaining feeds were also weighed. The data obtained was included in the calculation of G:F.

2.3. Sample collection and analyses
At the end of experiment (21 d of age), all birds were weighed and one bird from each of ten replicates that had weight closed to the mean weight of birds per cage was chosen for dissection. Prior to dissection, the birds were not given any feed for about 8 hours. The birds were dissected at the jugular's vein. The dissection was done in compliance with Indonesia guide lines for animal handling and care [11].

2.4. Digestive organs weight
After the birds were killed, the body cavity was immediately opened, and the GIT was removed and weighed before and after removing the content. The gizzard with content and pancreas was also removed. The gizzard content was also collected. The weight of empty gizzard, GIT, including pancreas was expressed relative to 100 g live BW (without digesta) (g/100 g BW), whereas the weight of digestive content was expressed relative to 100 g live BW (g/100 g BW).

2.5. Statistical analysis
One-way analysis of variance [12] was used to analyse the data. When F test was significant, to inspect differences among group means we used Duncan's multiple range test. Statistical significance was determined at $P \leq 0.05$.

Table 1. Diet composition and nutrient content (as-fed basis).

Ingredient, g/kg	CON	SRH	IRH
Corn	527.40	527.40	355.70
Wheat bran	87.90	87.90	161.70
DDGS	78.90	78.90	76.30
SBM	128.50	128.50	120.90
PBPM	143.10	143.10	155.60
Palm oil	6.20	6.20	63.80
Rice hulls	-	-	40.00
NaCl	3.30	3.30	3.30
Lysin	0.30	0.30	0.10
DL-methionin	1.10	1.10	1.20
Mineral Mix	5.00	5.00	5.00
Ca_2PO_4	12.70	12.70	11.40
$CaCO_3$	5.60	5.60	5.00
Rice hulls	-	40.00	-
Nutrients (calculated), %			
ME, kcal/kg	3000.00	3154.00	3000.00
CP	23.00	23.00	23.00
EE	4.74	4.74	10.31
CF	3.09	5.09	5.53
Ca	1.00	1.00	0.94
Total P	0.90	0.90	0.98
Na	0.20	0.20	0.20
Lysin	1.10	1.10	1.10
Methionin	0.50	0.50	0.50

3. Results

The results are summarized in Table 2. The ADG and ADFI of birds from 2 to 7 d of age and from 7 to 14 d of age was not affected ($P > 0.05$) by the inclusion or supplementation of rice hulls. But from 14 to 21 d, broilers fed the IRH showed better ($P \leq 0.05$) ADG and ADFI than those fed the SRH and the CON. When we measured cumulatively, from 2 to 21 d of age, the IRH increased ($P \leq 0.05$) ADG more than the CON and the SRH, but the ADFI was similar among diets ($P > 0.05$). The effect of diets on GF in all periods was not significant ($P > 0.05$). Mortality was occurred during the first week of life (about 1 %) and it was not due to the treatment diet (data not shown).

Diets affected ($P \leq 0.05$) the weight of intestinal content and the weight of empty ceca, but the effects on the weight of empty gizzard was only tended to be significant ($P = 0.07$). Broilers fed the SRH had lower ($P \leq 0.05$) intestinal content than those fed the IRH and the CON which were not different. Birds fed the IRH had lower ($P \leq 0.05$) ceca weight and tended ($P = 0.07$) to have lower empty gizzard weight than those fed the SRH and the CON.

Table 2. Response of diets on growth performance and gastrointestinal weight.

Parameters measured	CON	SRH	IRH	SEM[1]	P-value
ADG, g/b/d					
2 to 7 d of age	15.65	15.90	16.07	0.163	0.59
7 to 14 d of age	26.10	27.04	26.97	0.491	0.70
14 to 21 d of age	42.06^{ab}	38.55^{a}	44.91^{b}	0.925	0.01
2 to 21 d of age	29.23^{ab}	28.35^{a}	30.71^{b}	0.375	0.03
ADFI, g/b/d					
2 to 7 d of age	19.90	20.17	20.41	0.211	0.63
7 to 14 d of age	46.18	47.04	45.26	0.837	0.70
14 to 21 d of age	64.10^{ab}	61.02^{a}	67.28^{b}	1.025	0.04
2 to 21 d of age	45.86	45.12	46.83	0.558	0.47
G:F, g/g					
2 to 7 d of age	0.788	0.788	0.789	0.007	0.99
7 to 14 d of age	0.577	0.574	0.596	0.012	0.75
14 to 21 d of age	0.658	0.635	0.673	0.015	0.59
2 to 21 d of age	0.640	0.629	0.657	0.080	0.37
Weight of empty digestive organs, % of BW (without digesta) at 21 d of age					
Gizzard	2.16	2.41	1.86	0.100	0.07
Small Intestine	3.26	3.49	2.80	0.141	0.12
Pancreas	0.37	0.33	0.32	0.017	0.49
Ceca	0.35^{b}	0.33^{b}	0.19^{a}	0.023	0.00
Weight of digestive content, % of live BW at 21 d of age					
Gizzard	1.07	0.95	1.00	0.050	0.61
Small Intestine	5.18^{b}	3.24^{a}	5.10^{b}	0.332	0.02
Ceca	0.46	0.38	0.31	0.039	0.30

[1]SEM: standard error of the mean
^{a,b}mean values within a row with different superscripts differ significantly ($P \leq 0.05$).

4. Discussion

Cumulatively, from 2 to 21 d of age, the inclusion of rice hulls increased ADG, but not G:F and ADFI, the ADFI only increased from 14 to 21 d of age. The inclusion of insoluble fiber sources at level up to 3% in low-fibre diet improved the growth performance of broilers [3]. Jiménez-Moreno et al. [1], including 2.5% of rice hulls (2mm in size) in broiler diets found an increase in average daily gain dan feed to gain ratio better than the control diet.

Sadeghi et al. [7] included 3% rice hulls (2 mm in size) in the diet did not find any significant effect on growth performance. We used 4% rice hulls (2 mm in size) in the present study and our diets contained an excess of fibre (about 5% CF in the diet). Based on the results in our present study, together with the information of Jiménez-Moreno et al. [1] and Sadeghi et al. [7], it suggests that the rice hull levels required to optimize growth performance of young broilers depend on diet composition. In our present study, the improvement of ADG observed from 14 to 21 d of age was consistent with an increase in ADFI. However, from 2 to 21 d of age, an increase in ADG on birds fed the IRH was not followed by an increase in ADFI, whereas those fed the SRH had the same ADG with the CON. So, it is likely that factors other than fibre was involved in increasing nutrient utilization of birds fed the IRH. The percentage of fat contained in the IRH is almost double than that contained in the SRH (10.31 % and 4.74 %, respectively). The higher dietary fat will reduce the rate of feed passage in the gut [13]. Presumably, the higher fat content in the IRH reduced digesta passage rate, allowing better nutrient utilization [13]. The fact that in our present study the intestinal content of birds fed the IRH was higher than those fed the SRH supported the suggestion.

The weight of empty ceca was lower in birds fed the IRH than those fed the SRH and the CON which were not different. If the nutrient utilization increased, substrates available for microorganisms might also reduce, consequently no much activity occurred in the ceca.

In our present study, inclusion of rice hulls tended to reduce the gizzard size, whereas the gizzard content was not different among diets. The results were differed from those reported by Hetland and Svihus [14] in their study with oat hulls. Different fibres have different physicochemical properties [9]. The insoluble fibre of rice hulls was almost 10% higher than that of oat hulls, whereas the soluble fibre was 59% lower than that of oat hulls [1]. The coarse oat hulls that was used in Hetland and Svihus [14] was ground through 1.6 mm sieve, whereas in our study the rice hulls were ground through 2 mm sieve. So, our data seem to indicate that the effects on size and content of the gizzard as a consequence of fibre inclusion were due to the physicochemical properties of the fibre rather than the particle size.

5. Conclusion

This study demonstrated that the inclusion or supplementation of rice hull did produce different effect on the growth performance and GIT weight of young broilers. However, diet composition rather than the individual fibre was suggested to be the factor that caused the differences. The diet composition due to rice hull inclusion affected the growth performance and GIT weight of broiler chickens more than the diet composition due to rice hull supplementation.

Acknowledgements

This work was supported by the Minister of Research and Technology of Higher Education Republic of Indonesia through contract No. 080/SP2H/L.T/DRPM/2018 under the National Competitive Grant, Competency-based Research. The support from PT. Japfa Comfeed Tbk in providing the research feedstuff is greatly appreciated.

References

[1] Jiménez-Moreno E, de Coca-Sinova A, González-Alvarado JM and Mateos GG 2016. *Poult. Sci.* **95**: 41-52
[2] Svihus B and Hetland H 2001. *Br. Poult. Sci.* **42**: 633 - 37
[3] Mateos GG, Jiménez-Moreno E, Serrano MP and Lázaro RP 2012. *J. Appl. Poult. Res.***21**: 156-74
[4] González-Alvarado JM, Jiménez-Moreno E and Mateos GG 2007. *Poult. Sci.* **86**: 1705-15
[5] Hartini S, Choct M, Hinch G, Kocher A and Nolan JV 2002. *J. Appl. Poult. Res.***11**:104-10
[6] Hartini S and Massora M 2014. *Proc. of the 14th European Poultry Conf.* (Stavanger, Norway) p. 561
[7] Sadeghi A, Toghyani M and Gheisari A 2015. *Poult.Sci.* **94**: 2734-43
[8] Hartini S and Purwaningsih P 2017. *Pak. J. Nutr*. **16** (4): 227-35
[9] Hartini S, Choct M, Hinch G and Nolan JV 2003. *Proc. Aust. Poult. Sci. Sym*. **15**: 135-138
[10] NRC 1994. 9th ed. (Washington, DC: National Academy Press).
[11] Decree of the Minister of Labor and Transmigration of the Republic of Indonesia 2014. No. 196
[12] SPSS 16.0 2007. *Command Syntax Reference, SPSS Inc*. (Chicago Ill.)
[13] Latshaw JD 2008. *Poult. Sci.* **87** (1): 89-95

[14] Hetland H and Svihus B 2001. *Br. Poult. Sci* **42**: 354-61

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