Feeding kampong chickens with infertile eggs: effects on 6-weeks performance

N Akhirini¹, W P S Suprayogi¹, A Ratriyanto², R F Hadi¹, W Setyono¹ and A Irawan¹

¹ Vocational Program of Animal Husbandry, Vocational School, Universitas Sebelas Maret, Surakarta 57126 Indonesia
² Graduate Program of Animal Husbandry, Faculty of Agriculture, Universitas Sebelas Maret, Surakarta 57126 Indonesia

Corresponding author: novi.akhirini@staff.uns.ac.id

Abstract. The present study evaluated the effect of dietary inclusion levels of infertile eggs powder (IEP) from the hatchery processing industry on the performance of kampong chickens measured at 6 weeks. A total of 120 birds at 21 d (327±18 gram) were equally distributed to receive 10%, 20%, and 30% of IEP with control treatment without IEP. Each treatment group was replicated five times with eight birds in each, giving three dietary treatments including control. Diets were formulated to meet the Indonesia National Standard of the nutrient requirement for kampong chickens. Results showed that increasing dietary IEP at 10% and 20% significantly increased average daily gain (ADG), final body weight (BW), and decreased feed conversion when compared to control (p<0.05). When given at 30%, no effect on production performance parameters was observed. In conclusion, the present study suggests that infertile eggs powder can be partially used to substitute conventional protein sources in kampong chickens. Dietary inclusion of IEP up to 20% given in mixed with corn in the formula improves the performance of kampong chickens without negatively affecting feed intake.

1. Introduction

Substantive increase in the demand for kampong chickens' meat has occurred in the last few years. Although rearing kampong chickens was perceived as traditional farming activity in the past, there has been a continuous increase in the population in the last decade due to its potential economic benefit. In the farm operational cost, considerable high feed cost is a major constrain, making the business process less competitive. Therefore, there is a gaining interest to formulate kampong chickens' feed with a specialized diet using the most economical value to have more profit. A large quantity of infertile eggs from hatchery processing has received researchers' interest to utilize it as an alternative protein source [1]. It is especially important to partially replace soybean meal since Indonesia most totally depends on importation for this ingredient. Therefore, utilization locally available resources such as infertile eggs as protein sources is a correct strategy to create sustainable feeding more efficiently.

Hatchery by-products including infertile eggs contain >30% crude protein (CP), making this ingredient valuable to be included in feed formula. Breeding farm flocks regularly result in up to 5% infertile egg and is commonly stamping out without further use. In other countries such as Brazil and South Korea, the hatchery by-products are cooked, dried, and ground and used in the formula of broiler
or laying hens’ diet. A number of previous experiments have demonstrated that the inclusion of infertile eggs or whole hatchery by-products could enhance the productive performance of broiler chickens. For instance, the inclusion of 4-6% egg powder in the broiler diet resulted in higher daily gain, better feed conversion, and healthier intestinal status [2]. A similar positive effect on broiler chickens in the starter phase was also reported in our previous study in Indonesia [1,3]. However, in South Korea, supplementing the broiler diet with 5% mixed hatchery by-products improved lipid stability of broiler meat as indicated from the decrease in polyunsaturated fatty acids concentrations [4] without any effect on growth performance.

To our knowledge, there is no information on using infertile egg powder in kampong chickens. It is well known that genetically speaking, kampong chicken has a slower growth rate compared with broiler chickens. However, their economic value is promising. To support a higher growth rate, it is important to provide kampong chickens with an easily digestible ingredient such as infertile egg powder. The provision of such ingredients is hypothesized to beneficially enhance the digestive tract of kampong chickens as well as enhance immunity because it has natural protein which acts as an immunomodulator [2]. Therefore, the present study intended to evaluate dietary levels of infertile egg powder on the production performance of kampong chickens at 6 weeks of rearing period.

2. Materials and methods

2.1. Animals, experimental design, and diets formulation

The experiment was conducted in the experimental farm of the Department of Animal Science, Universitas Sebelas Maret, Indonesia. All facilities were provided to meet the standard of animal welfare including space, ventilation, lighting, drinking water, and security. In total, 120 days-old chicks (DOC) male of Indonesian native chickens were allocated to receive one of the three dietary treatments where each treatment consisted of four replicates (8 birds in each). The DOCs were purchased from a local hatchery in Surakarta, Indonesia, and the sexes were determined on arrival.

| Parameters          | Composition |
|---------------------|-------------|
| Crude protein (%)   | 48.38       |
| Crude fiber (%)     | 0.87        |
| Ether extract (%)   | 35.36       |
| Calcium (%)         | 0.32        |
| Phosphorus (%)      | 0.63        |
| ME (kcal/kg)        | 5,667.7     |

1) Calculated according to Sibbald et al. [5]

| Chemical composition (% except as provided) | Starter | Finisher |
|---------------------------------------------|---------|----------|
| Metabolizable energy (Kcal/kg)              | CON     | 10% IEP  | 20% IEP  | 30% IEP  |
| Crude protein                               | 21.21   | 18.00    | 18.00    | 18.00    |
| Crude fiber                                 | 3.28    | 4.19     | 4.08     | 3.95     |
| Ether extract                               | 4.07    | 6.21     | 5.94     | 7.09     |
| Calcium                                     | 1.09    | 1.22     | 1.22     | 1.22     |
| Available phosphorus                         | 0.43    | 0.90     | 0.90     | 0.90     |

CON= control; IEP = infertile egg powder

The treatments were according to the inclusion levels of infertile eggs (IE) in formula (CON = without IE; T1 = inclusion of 10% of IE; and T2 = inclusion of 20% of IE; and T3 = inclusion of 30% of IE in the formulated diets). Infertile eggs were obtained from a commercial hatchery located in Boyolali, Central Java, Indonesia. The IE was prepared in powder form where the preparation was
according to the previous methods by [3]. The chemical composition of IE powder is provided in Table 1 where the dietary compositions of each treatment group are presented in Table 2.

The dietary treatments were formulated to meet the nutrient requirements of the National Indonesia Standard [6] both for starter and finisher. The birds were raised in brooders for 10 days following their arrival. The birds received a Newcastle Disease vaccine on day 4 and Infectious Bursal Disease (Gumboro) on day 13. Feed and drinking water were provided ad libitum for 42 days. Lighting was scheduled following the recommendation of the Ross Broiler Handbook where the room temperature was set at 30°C and gradually decreased to 24°C [7].

2.2. Sample collection and chemical analyses

Body weight was observed on weekly basis by weighting all birds in each pen (replicate). Feed intake and mortality were recorded daily where feed conversion ratio (FCR) was calculated weekly by dividing the feed intake with BWG corrected for mortality. In the end, two birds per pen were euthanized to measure the organ weight (carcass, digestive organs, and lymphoid organs). The chemical composition of the feedstuff used in the formulation was analyzed for dry matter (DM), organic matter (OM), Crude Protein (CP), crude fiber (CF), ether extract (EE), ash, calcium, and phosphorus using AOAC [8] procedures.

2.3. Statistical analysis

Data were analyzed using one-way ANOVA by employing the GLM procedure of SAS (SAS Studio 3.8, University Edition, 2018) considering the treatment units as fixed effect and replication as a random effect. The significant statement was declared when p < 0.05. In this case, a post hoc test was performed using Tukey’s HSD to compare the least-square means among treatments.

3. Results and discussion

Proximate analysis showed that IEP used in the present study (Table 1) was comparable with previous studies reporting the chemical composition of infertile eggs from the hatchery processing industry [1,4]. Data on Kampong Chickens’ performance are presented in Table 3. Increasing dietary IEP to partially replace SBM affected final body weight (BW) measured at 42 d (p<0.05) whereas increasing IEP proportion up to 20% increased BW. However, such an effect was not detected when IEP was supplemented at 30%. Similarly, treatments with 10% and 20% IEP had higher feed intake when compared with control and 30% IEP (p<0.05). This led to concomitantly lower feed conversion for 10% and 20% treatment than that of 30%. Nevertheless, these treatments were not significantly different from the control. The mortality rate for all treatment groups receiving IEP was similar, indicating that there was no depressing effect from infertile egg powder used in this experiment.

Table 3. Productive performance of kampong chickens measured at 6 weeks of age

| Variables             | Treatments          | S.E.M | p-value |
|-----------------------|---------------------|-------|---------|
|                       | CON                 | 10% IEP | 20% IEP | 30% IEP |       |
| Feed intake (g)       | 1.210.2b            | 1.288.5a | 1.217.7a | 1.257.2ab| 22.67  | <0.05  |
| Final body weight (g) | 508.5c              | 570.8a  | 546.8b  | 510.5c  | 16.02  | <0.05  |
| Average daily gain (g/d)| 64.2b              | 74.9a   | 72.6a   | 66.8b   | 3.00   | <0.05  |
| Feed conversion ratio | 2.38b              | 2.26b   | 2.23b   | 2.49a   | 0.085  | <0.05  |
| Mortality (%)         | 0.25                | 0.25    | 0.25    | 0.00    | 0.01   | <0.05  |

CON= control; IEP = infertile egg powder; S.E.M = standard error of the means; * b c Different superscripts within row significantly differ at p<0.05

The results of the present study were similar to most of the studies conducted previously where IEP can be used to improve chickens' performance [2]. Since all previous studies were conducted on broiler chickens, it is suggested that kampong chicken has similar physiological responses to dietary IEP. To our knowledge, this is the first study reporting the influence of IEP on kampong chickens. The improvement effect found in this study might be attributed to the characteristics of IEP which contained balance nutritional profiles as well as antibodies materials and bioactive constituents [3,9]. It was also
reported that IEP has a higher digestibility value than conventional protein sources. The hatchery by-products were reported to contain a high concentration of available nutrients such as amino acids, Calcium (Ca), and phosphorus (P) contents for animals. Previous studies have reported that the infertile egg from hatchery can be used as economical ingredients and a potential protein alternative for poultry diets [2,10]. Beski et al. [11] found higher palatability and digestibility of hatchery byproducts than that of fish meal and SBM. In addition, egg preserves as an excellent source of nutrients for embryo development and post-hatch chicks. Thus, it is easily used by birds for metabolism and growth, promoting better performance.

Supporting evidences are available whereas IEP inclusion promotes improve digestive tracts development and enhances immune status in broiler chickens [2,10]. It was also reported to modulate intestinal microorganisms due to the bioactive components and lysozyme contained in eggs [12]. Esmailzadeh [2] reported a decreased in E. coli and an increased in lactic acid bacteria population in birds fed diets containing infertile eggs. They also found that intestinal morphology was improved as indicated by the higher villus height, villus to crypt ratio, and intestinal length relative to BW. All of these evidences supported our findings that infertile eggs have some functional properties other than good nutrient sources. As shown in Table 3, IEP inclusion had no adverse effects on feed intake and mortality, suggesting that IEP is safe and can be used in poultry feed formula.

4. Conclusion
In conclusion, the present study suggests that infertile eggs powder can be partially used to substitute conventional protein sources in kampong chickens. Dietary inclusion of IEP up to 20% in the feed formula was acceptable and could improve kampong chickens' performance without any adverse effects on feed intake and other performance variables. In addition, IEP inclusion in the diet might be promising especially to lower feed cost because the material had low cost than soybean meal. Therefore, evaluation of income over feed cost is necessary.

Acknowledgment
The authors thank the Institute of Research and Community Service of Universitas Sebelas Maret (LPPM UNS) for the financial support through research group research scheme (HGR-UNS; contract no. 260/UN27.22/HK.07.00/202) of 2021 fiscal year.

References
[1] Ratriyanto A, Pratitis S S W and Atikah R 2020 *IOP Conf. Ser. Earth Environ. Sci.* 518 012005
[2] Esmailzadeh L, Shivazad M, Sadeghi A A and Karimirshizhi M 2016 *Rev. Bras. Cienc. Avic.* 18 705–10
[3] Ratriyanto A, Suprayogi W S P, Lestari A P, Riandari S F and Akbar A 2021 *IOP Conf. Ser. Earth Environ. Sci.* 637 012069
[4] Choi W J, Kim J H, Han G P, Kwon C H and Kil D Y 2021 *Asian Australas. J. Anim. Sci.* 1–23
[5] Sibbald I R, Price K and Barrette J P 1980 *Poul. Sci.* 59 8–11
[6] Standar Nasional Indonesia [SNI] 2018 *Pakan Ayam Kampung* (Jakarta: BNSP)
[7] Aviagen 2018 *Broiler: nutrition specifications* (Huntsville, USA: Aviagen Inc) http://en.aviagen.com/
[8] AOAC 2005 *Official Methods of Analysis* 16th ed Arlington (VA: Association of Official Analytical Chemists, International)
[9] Frempong N S, Nortey T N N, Paulk C and Stark C R 2019 *J. Appl. Poul. Res.* 28 912–8
[10] Abiola S S and Onun K E K 2004 *Bioresour. Technol.* 95 103–6
[11] Beski S S M, Swick R A and Iji P A 2015 *Anim. Nutr.* 1 47–53
[12] Nasution S, Kusumaningtyas E, Faridah D N and Kusumaningrum H D 2018 *Wartazoa* 28 175–88