

THE EFFECT OF ADDITION OF INFERTILE EGG FLOUR IN RATION ON THE LENGTH OF DUODENUM, JEJUNUM, ILEUM, AND THE WEIGHT OF GIZZARD IN SUPER NATIVE ROOSTERS

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ABSTRACT

This study is aimed to examine the effect of addition of infertile egg flour inside the ration toward the length of small intestine (duodenum, jejunum, ileum), and the weight of gizzard on super native roosters. This research used 120 super native roosters. The design used a complete randomized design by one directional pattern through 4 treatments and 5 replications which each replication consists of 6 chickens. The treatments included P0 (100 % basal ration + 0 % infertile egg flour), P1 (96,7 % basal ration + 3,3 % infertile egg flour), P2 (93,4 % basal ration + 6,6 % infertile egg flour), and P3 (90,1 % basal ration + 9,9 % infertile egg flour). The data was collected when chickens were 2 months old by slaughtering 2 chickens for each replication. The data was analyzed variously therefore when the significant results were obtained, it will be tested using Duncan's Multiple Range Test. The results showed that unreal differences of the length of duodenum, jejunum, and ileum were ($P > 0,05$) and real difference of the weight of gizzard was ($P < 0,05$). The conclusion of this study was that the use of infertile egg flour in the diet of super native roosters did not increase the length of the duodenum, jejunum, and ileum, but it increased gizzard weight. Infertile egg flour can be used as an ingredient in rations up to a level of 9.9%.

Keyword: duodenum, *gizzard*, ileum, infertile egg flour, jejunum, super native roosters

1. Introduction

Indonesia is a country where the demand of poultry meat increases every year. One of the superior types of poultry is super native roosters. Supernative roosters are produced by breeding of male chickens and layer chickens (kusumawati et al., 2016). The supernative rooster physics grows faster than others meanwhile it produces fat content in a small amount. The harvest period of supernative roosters is about 2-3 months which is different compared to native rooster which can be consumed after it is 4 months old (Mulyono and Raharjo, 2002). Besides, the superiority possessed by super native roosters are having good resistance, resistance to various types of diseases and resistance to heat stress, In addition supernative roosters definitely offers some advantages, such as it needs short maintenance time, more cost-effective feed, while the demand and its sale price are constantly high (setiawan et al., 2019).

The preparation of the ration is one of the important factors in the maintenance of super native roosters. The prepared rations should be available in liveatock area, it is durable to be stored, palatable (favored by livestock), meet the nutritional needs of livestock, and the price is relatively cheap. Recently, the availability of raw materials for rations is very limited, due to the narrowness of agricultural land and the competition for basic human needs with livestock. Treatment of waste from the livestock industry is one solution to overcome the limited availability of feed raw materials. One of the wastes that can be utilized is waste from the hatchery industry, namely infertile eggs. Infertile eggs defines as eggs which do not develop embryo at the time of hatching. The eggs have been entered into the hatchery, but during the candling process no embryos were found inside.

Digestibility of feed ingredients is much influenced by the organs of the digestive tract. Generally, the morphology of the digestive tract describes the health condition of livestock and the ability of the digestive tract (Sitompul et al., 2020). The digestive tract of super native roosters develops morphologically and physiologically along with its age. The development of the digestive tract is an indicator of the ability to utilize nutrients for basic life, production, and health. The factors that influence the development of the digestive tract are the quality and quantity of feed consumed (Ardiani et al., 2016). Based on the description above, it is necessary to conduct research on the effect of adding infertile egg flour to the diet of super native roosters on the length of the duodenum, jejunum, ileum, and gizzard weight.

2. Material and Methods

2.1 Animals, Experimental Design, and Diet Formulation

This research was conducted at the Jatikuwung Experimental Farm in Jatikuwung Village, Gondangrejo District, Karanganyar Regency and the Laboratory of Nutrition and Animal Feed Science,

Animal Husbandry Study Program, Faculty of Agriculture, Sebelas Maret University, Surakarta. The type of livestock used in this study was male super native roosters. Weighing was done on the third day after chick in and the average body weight was 32 grams. This study used 4 treatments with 5 replications and each replication consisted of 6 chickens so that the total was 120 male super native roosters. The chicken samples used in this study were two chickens for each replication so that 40 chickens were obtained to evaluate their digestive organs. Samples of slaughtered chickens were taken from chickens with high body weight. The equipment used is a cage, feed, drinking place, incandescent lamp, scales, equipment for slaughter, and carcass. Infertile eggs were obtained from a commercial hatchery located in Boyolali, Central Java, Indonesia

Table 1. Chemical composition of infertile eggs powder *

Parameters	Composition
Crude protein (%)	48,38
Crude fiber (%)	0,87
Ether extract (%)	35,36
Calcium (%)	0,32
Phosphorus (%)	0,63
ME (Kcal/kg)	5667,7

*)Calculated according to Sibbald *et al.* (1980)

Table 2. Diet composition of the treatment groups in starter and finisher

Chemical composition	Starter	Finisher			
		CON	IEP 3,3 %	IEP 6,6 %	IEP 9,9 %
Metabolizable energy (Kcal/kg)	3051	2900	2900	2904	2995
Crude protein (%)	21,21	18	18	18	18
Crude fiber (%)	3,28	3,58	3,67	3,76	3,87
Ether extract (%)	4,07	7,79	7,30	6,90	8,25
Calcium (%)	1,09	1,05	1,05	1,05	1,06
Available phosphorus (%)	0,43	0,72	0,75	0,77	0,80

CON : control

IEP : infertile egg powder

2.2 Sample Collection

The chicken is slaughtered when it is 8 weeks old. The slaughter sample of each treatment is 2 chickens until it is obtained 40 chickens. The process of slaughtering super native chickens begins by not feeding the chickens for 12 hours which is aimed to deplete the remaining food inside the digestive tract. Slaughter is done by cutting the trachea, esophagus, carotid artery, and jugular vein, after that the feather is plucked out and then expel the internal organ (evisceration). Evisceration

is done by slashing the bottom of the chicken breast, then the internal organs are pulled out.

Duodenum is the first part of the small intestine that carries out digestion and absorption of feed nutrients. It is located very close to the body wall and is attached to a short mesentery, the mesoduodenum (Badrussalam et al., 2020). Duodenum is measured from the gizzard border to the rotation of the pancreas. Jejunum is the longest part of the small intestine (Badrussalam et al., 2020). Jejunum is defined as the middle segment of the small intestine between the end of the duodenum and Meckel's diverticulum (Harimurti and Rahayu, 2009). The ileum is the small intestine that extends from the meckel's diverticulum to the beginning of the ceca branching (Harimurti and Rahayu, 2009). The lengths of the duodenum, jejunum, and ileum were measured one by one using a rope then cut and labeled according to names so as not to be confused, after measuring all, the ropes were measured one by one using a measuring tape.

The gizzard is an organ that plays an important role in breaking down food particles into smaller ones so that they are easily digested by chickens (Jumiati et al., 2017). The gizzard is located between the proventriculus and the junction of the duodenum. The gizzard is weighed after being split and the contents removed. Gizzard weights were weighed using an analytical balance (Rahma et al., 2022).

2.3 Statistical Analysis

The study was carried out using a completely randomized design (CRD), to determine the effect of treatment on the observed variables. If the results of the data analysis are significantly different, it is continued with Duncan's Multiple Range Test (DMRT) to determine the difference between the four treatments.

3. Result and Discussion

Table 3. Average length of duodenum, length of jejunum, length of ileum, and weight of gizzard

Variables	Treatments				P Values
	P0	P1	P2	P3	
Duodenum (cm)	23,29 ± 2,78	24,18 ± 1,75	24,77 ± 2,29	24,55 ± 3,72	0,836
Jejunum (cm)	50,18 ± 4,47	51,61 ± 3,36	51,36 ± 4,37	53,02 ± 7,12	0,847
Ileum (cm)	45,34 ± 4,34	45,41 ± 3,07	44,17 ± 4,84	47,57 ± 6,27	0,727
Bobot gizzard (g)	26,08 ± 3,30 ^a	31,66 ± 1,54 ^b	32,72 ± 4,41 ^b	35,32 ± 4,11 ^b	0,006

Description: ^{a,b} different superscripts on the same line show a significant difference (P<0.05)

3.1 The Length of Duodenum

The result of the analysis of variance concerning on the length of the duodenum of 8 weeks old super native roosters with infertile egg flour up to 9,9% level showed that the results were not significantly different ($P>0,05$). It indicates that the mean length of the duodenum of the super native roosters in each treatment in this study was not statistically different. This unsignificantly different result was presumable because the consumption of crude fiber by super native roosters was almost the same between treatments. The length of the small intestine is influenced by the crude fiber content in the feed, if the crude fiber content in the feed is high, the intestines will work harder and eventually increase its size. Herlina and Novita (2021) stated that intestinal development is influenced by the crude fiber content consumed by chickens. This is supported by the opinion of Retnoadiati (2001) which states that for rations that require intensive absorption, the intestine will expand its surface by thickening the intestinal wall or lengthening the intestine so that many nutrients are absorbed by the intestine. Amalia et al. (2019) stated that the size of the small intestine affects the capacity of the small intestine to digest and absorb feed nutrients. The high crude fiber in the feed causes the digesta rate to be slow. A slow digesta rate is expected to increase body weight, because the nutrients needed by the body are digested properly (Setyanto et al., 2012). This is in line with the opinion of Sjöfjan et al. (2020) which states that a slow digesta rate allows an increase in the digestive process and a more effective absorption of feed nutrients, so that the availability of nutrients for the synthesis of body tissues increases.

The length of the duodenum is closely related to the length of the villi and the relative weight of the duodenum where the longer the intestinal villi, the wider the surface for nutrient absorption and the optimal absorption of nutrients, causing the duodenum to be heavier and longer (Satimah et al., 2019). Raditya et al. (2013) reported that the duodenum is part of the small intestine that functions as the absorption of water, sodium, and other minerals. Digestion occurs in the duodenum with the breakdown of crude nutrients in the form of starch, fat, and protein. The duodenum secretes the enzymes trypsin, amylase, and lipase from the pancreas and bile from the liver to digest feed. Anggorodi (1995) stated that the duodenal wall will secrete enzymes that can increase the pH of incoming food substances, so that solubility and absorption in the jejunum and ileum will increase. The average length of the duodenum in this study starting from P0, P1, P2, and P3 was 23,29 cm, 24,18 cm, 24,77 cm, and 24,55 cm, respectively. The length of the

duodenum is still in the normal range according to research from Ibrahim (2008) that the average length of the duodenum is 24,41 cm.

3.2 The Length of Jejunum

Based on the results of statistical analysis, it showed that the jejunum length of super-village chickens aged 8 weeks with the provision of infertile egg flour up to a level of 9,9% showed no significant difference ($P>0,05$). This indicates that the mean length of the jejunum of super native roosters treated with infertile egg flour in this study was not statistically different. This insignificantly different result was presumably because the consumption of crude fiber by super native roosters was almost the same between treatments. The provision of the same crude fiber in the feed will not have a different effect on the length of the small intestine of super native roosters. High crude fiber will lengthen the size of the small intestine. This is supported by the opinion of Jones and Taylor (2001) who stated that the length of the small intestine can be increased due to the provision of rations that contain lots of cereals and high fiber. Yao et al. (2006) stated that by increasing length and weight of the small intestine, the inner surface and surface area of the small intestine also increased, so that to a certain extent there was an increase in the digestibility and absorption of nutrients by the small intestine.

Amrullah (2003) reported that changes in intestinal length were followed by the number of intestinal villi. Increased levels of crude fiber in the ration tend to lengthen the intestines where the higher the crude fiber in the ration, the slower the rate of feed and the absorption of feed nutrients. Anggorodi (1995) stated that the jejunum has a function as an activator of feed flow in the intestine and also to increase the absorption surface of feed nutrients. Yuwanta (2004) suggested that the jejunum is the main place for absorption of food substances, in which chemical digestion occurs by enzymes produced from the walls of the small intestine. The enzymes produced are enterokinase, erepsi, maltase, disacrase, peptidase, sucrase, and lipase enzymes. Jejunum is a continuation of the duodenum where there is a process of absorption of nutrients that has not been completed in the duodenum until undigested material remains. Amrullah (2003) stated that most of the absorption of nutrients occurs in the jejunum. The average length of the jejunum of super native roosters for treatment P0, P1, P2, and P3 were 50.18 cm, 51.61 cm, 51.36 cm, and 53.02 cm, respectively. The length of the jejunum in this study was lower than that of Sitorus and Telambanua (2021) that the jejunum length ranged from 58.5 to 72.5 cm.

3.3 The Length of Ileum

The results of the analysis of variance on the ileum length of super-village chickens aged 8 weeks with the provision of infertile egg flour up to a level of 9,9% showed that the results were not significantly different ($P>0,05$). This indicated that the provision of each treatment ration did not show a significant effect on increasing the ileum length of super-range chickens. This unsignificantly different result was presumably because the consumption of crude fiber by super native roosters between treatments was almost the same. The length of the small intestine is influenced by the crude fiber content in the feed, if the crude fiber content is high, the small intestine will be longer. This is in accordance with the opinion of Hermana and Aliyani (2003) which states that the length of the small intestine in chickens fed with high crude fiber diet causes protein to be difficult to degrade, so that the length of the small intestine is longer than that of low crude fiber feeds. The length of the ileum can also be affected by the rate of digestion, the slower the rate of ileal digestion, the more complete the absorption of nutrients. Maradon et al. (2015) stated that a slow digesta rate allows enzymes to hydrolyze food substances longer so that the absorption of feed nutrients will be effective and feed digestibility will increase.

Wang et al. (2016) suggested that a longer small intestine is an indication of a larger absorption area, which in turn will increase nutrient utilization and absorption. Ayu (2022) suggested that the difference in ileal length was caused by differences in the ability of the intestines to absorb feed nutrients. The growth of small intestinal villi is closely related to the potential of the small intestine to absorb feed nutrients. This is in line with the opinion of Lenhard and Mozes (2003) which states that the higher the villi of the small intestine, the greater the effectiveness of absorption of feed nutrients through the epithelium of the small intestine. The ileum acts as a place for water and mineral absorption although further nutrient absorption still occurs here (Shivus, 2014). The average ileal length in this study at P0, P1, P2, and P3 treatments were 45,34 cm, 45,41 cm, 44,17 cm, and 47,57 cm, respectively. The length of the ileum in this study was within normal limits and in accordance with research from Sitorus and Telambanua (2021) that the range of ileal length was 38-48 cm.

3.4 The Weight of Gizzard

The results showed that the provision of infertile egg flour in the ration up to a level of 9,9% had a significant effect ($P<0,05$) on the gizzard weight of 8-week-old super-male chickens. The results of the follow-up test (DMRT) treatment of P0 with P1, P2 and P3 showed significantly different results ($P<0,05$). This is presumably because P0's

feed consumption is less than P1, P2, and P3. The average feed consumption of the results of this study for treatments P0, P1, P2, and P3 respectively were 1806,7 g, 1887,2 g, 1826,6 g, and 1865,7 g. The size of the gizzard is influenced by its activities. Gizzard muscle activity will occur when feed enters it, when the ration enters the body a metabolic process occurs. This metabolic process affects the activity of the gizzard (Akoso, 1993). Consumption of more feed will result in the capacity of the gizzard volume being wider, so that the work of the gizzard becomes harder. This causes the muscles of the gizzard to become larger due to physically digesting the feed, eventually the gizzard expands and becomes thicker. This is reinforced by the opinion of Pangesti et al. (2016) which states that giving more feed will result in a greater burden on the gizzard to digest feed, as a result, the gizzard tendon will be thicker, thus increasing the size of the gizzard. This is in line with the opinion of Sutrisna (2011) which states that increasing the activity of the gizzard in grinding feed can cause the gizzard's tendon to become thicker due to a more active contraction by the gizzard muscle. Jumiaty et al. (2017) stated that gizzard weight was determined by body weight, as well as the amount, nature, texture roughness and crude fiber content of the feed.

The results of the follow-up test (DMRT) P1, P2, and P3 showed that the results were not significantly different ($P>0,05$). The influencing factor was not significantly different from the rations P1, P2, and P3 given to the gizzard weight, namely the rations given to each treatment had nutrient levels that did not differ much between treatments. This is in accordance with the statement of Rahma et al. (2022) that ration nutrients play an important role in producing gizzard weight. The composition of nutrients in the ration will directly affect the activity of the gizzard. The average weights of gizzards P1, P2, and P3 respectively were 31,66 g, 32,72 g, 35,32 g. This size is still within the normal range and is in line with the research of Pangesti et al. (2016) which states that the average weight of chicken gizzard is 35,22 g. The gizzard is the muscular stomach usually associated with chicken teeth. The grit (small stones) in the gizzard function to grind or grind food mechanically so that it becomes smaller, smoother, and softer (Widodo, 2020).

4. Conclusion

Based on the results of the study, it can be concluded that the use of infertile egg flour in the diet of super native roosters did not increase the length of the duodenum, jejunum, and ileum, but it increased gizzard weight. This shows that infertile egg flour can be used as an ingredient in rations up to 9.9% level.

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