Journal AgroVet (Agro Veteriner)
https://e-journal.unair.ac.id/agrovet/index

Journal Agro Veteriner (Agrovet) Vol. 7 No. 1 2023: 23-28.

Commercial Feed Substitution with Milkfish Waste Flour (*Chanos chanos*) Against Quail (*Coturnix coturnix japonica*) Egg White Index, Egg Yolk Index and Haugh Unit

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ABSTRACT

Quail farming is quite developed, from year to year the population increases. The search for alternative feed as a substitute for feed sources is an effort by breeders to minimize feed costs. One alternative to replace feed ingredients can be fishery industry waste. Fishery waste that can be used as feed is milkfish waste (*Chanos chanos*). The purpose of this research was to determined the substitution of milkfish waste flour (*Chanos chanos*) at commercial feed to egg white index, egg yolk index and haugh unit. There are 20 quails (*Coturnix coturnix japonica*) at one day of age of four treatments and five replications. Each treatment consisted by five females. The treatment consisted of P0 with commercial feed 100%, P1 with commercial feed 98% + milkfish waste flour 2%, P2 with commercial feed 96% + milkfish waste flour 4% and P3 with commercial feed 94% + milkfish waste flour 6%. Based on the results of the Analysis of Variance (ANOVA) there was not significantly different (p>0,05) on egg white index, egg yolk index and haugh unit. It can be concluded the substitution of commercial feed with milkfish waste flour (*Chanos chanos*) can maintain egg white index egg yolk index and haugh unit.

ARTICLE INFO

Original Research

Received:
November 13th, 2023

Accepted:
November 28th, 2023

Published:
December 1st, 2023

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DOI:

How to Cite:
Purwantoro ANA, Hidanah S, Wardhana DK, Arif MAA, Warsito SH, Lokapirnasari WP. Commercial Feed Substitution with Milkfish Waste Flour (*Chanos chanos*) Against Quail (*Coturnix coturnix japonica*) Egg White Index, Egg Yolk Index and Haugh Unit. J. Agrovet. 2023, 7(1): 23-28.

Keywords: Quail, milkfish waste flour, egg white index, egg yolk index, haugh unit

Introduction

Quail farming is quite developed, from year to year the population increases. Bagh *et al.* (2016) stated that female Japanese quail (*Coturnix coturnix japonica*) can produce 250-300 eggs a year with an average weight of around 10 g/egg. Quail eggs are popular with the public because of their taste and complete nutritional content, namely 13.30% crude protein, 11.99% crude fat, 1993 kcal/kg metabolic energy, as well as various minerals and vitamins. The quail population in 2014–2018 in Indonesia increased from 12,692,000 to 14,877,000 individuals (Sujana *et al.*, 2020). Female quail begin laying eggs at the age of 41 days with peak production reaching 76% at the age of 5 months (Nasution, 2007).

The search for alternative feed as a substitute for feed sources is an effort by breeders to minimize feed costs. This can be done by utilizing waste materials that are underutilized by humans but have good nutritional content, are available in large quantities, are easy to obtain, are cheap and have nutritional value. One alternative to replace feed ingredients can be fishery industry waste. The use of fish meal in quail feed is a maximum of 8% of the total feed formulation (Yusuf *et al*., 2020). Fishery waste that can be used as feed is milkfish waste (*Chanos chanos*) (Pinandoyo *et al*., 2019). Milkfish waste (*Chanos chanos*) comes from processed waste from the milkfish processing industry (Wulandari and Kusumasari, 2019). Thornless milkfish is a type of milkfish preparation that leaves the bones behind.

Bone is a hard component that is not easily broken down by decomposers so it becomes waste and can cause environmental pollution (Siracusa, 2019). Apart from bones, there are also parts of milkfish that become waste, namely scales (Muzaki *et al*., 2021). The results of the analysis of the Veterinary Services and Feed Testing Unit, Faculty of Veterinary Medicine, Airlangga University, prove that milkfish waste that has been made into flour has a Dry Matter (DM) content of 96.38%, Crude Protein (CP) 54.582%, Crude Fat (LK) 6.366 %, Crude Fiber (CF) 3.0581%, Ash 15.802%, Calcium (Ca) 9.046%, Extract Material Without Nitrogen (BETN) 18.998% and Metabolic Energy (ME) 2977.85%. The protein content of milkfish waste (*Chanos chanos*) can certainly influence the egg white index, egg yolk index and haugh unit in Japanese quail (*Coturnix coturnix japonica*).

Protein consumption can affect the quality of egg whites. The quality of egg white depends largely on the amount of ovomucin secreted by the magnum. Ovomucin is the main ingredient that determines egg white height and the formation of ovomucin depends on protein consumption (Omana *et al*., 2010). Khaleel (2019) stated that the haugh unit value is influenced by egg weight and albumin height. The HU value is influenced by the protein content in the feed, especially lysine and methionine. The higher the protein consumed, the higher the egg weight and the viscosity of the albumin. Until now there has been no research regarding the use of milkfish waste (*Chanos chanos*) as fish meal and its effect on the egg white index, egg yolk index and Haugh Unit in Japanese quail (*Coturnix coturnix japonica*).

Materials and methods

Research design

This research was carried out in several places, namely, the analysis and manufacture of milkfish waste flour was carried out at the Animal Food Laboratory, Faculty of Veterinary Medicine, Airlangga University, maintenance was carried out on Jl. East Suterejo X / 11 East Surabaya. This research will be carried out for 55 days and is divided into three phases. This research was conducted from May 2021 to July 2021.

The number of replications used for each treatment group was 5 replications. The total experimental animals were 20 Japanese quail (*Coturnix coturnix japonica*). Sample selection was carried out randomly using simple random sampling.

Feed preparation

This research began with the process of making milkfish waste flour. The milkfish waste that has just been obtained is then washed with running water until the dirt is gone and then dried in the oven. The dry waste is then ground using a grinding machine to form milkfish waste flour.

Then for commercial feed it is ground first to make flour. Then the commercial feed which has become flour is mixed with milkfish waste flour. Feeding and drinking is done twice a day every morning and evening. Drinking water is provided ad libitum.

Preparation of experimental cages

The Japanese quail used in this study started at one day old or day old quail (DOQ). The cage, feeding equipment and drinking water used must be cleaned first.

The bottom of the cage is covered with newspaper which has been crumpled beforehand so that it is not slippery for DOQ. Incandescent lights were installed and food and water containers were provided in each cage.

Adaptation phase

The environmental adaptation phase is carried out when the quail are 1-7 days old. At this time, quail are given commercial feed ad libitum.

The feed adaptation phase is carried out when the quail are 8-14 days old. At this time, the control group of quail (P0) was given commercial feed without the addition of milkfish waste meal.

The quail treatment groups P1, P2, and P3 added milkfish waste flour in commercial feed with increasing concentrations with a break of one day for a week.

Treatment phase

The treatment phase in this study began when the quail were 15 days old, so the length of the treatment phase was forty days (range 15-55 days of age for the quail).

The treatment feed given to each group per replication was carried out based on the following treatment dose P0: 100% commercial feed; P1: 98% commercial feed and 2% milkfish waste meal; P2: 96% commercial feed and 4% milkfish waste meal; P3: 94% commercial feed and 6% milkfish waste meal.

Data retrieval phase

Data collection related to egg white index, egg yolk index and Haugh Unit can be carried out in the last week of research or the last 7 days. Data can be taken when the egg weight has been weighed. The calculation formula is as follows: egg white index, namely the height of the egg white (albumen) divided by the average diameter of the thick egg white (mm), egg yolk index, namely the height of the egg yolk (mm) divided by the average diameter of the egg yolk (mm), Haugh Unit (HU) is calculated based on the height of the egg white and the weight of the egg.

Data analysis

The data obtained were analyzed statistically using one way Analysis of Variance (ANOVA) using SPSS for Windows 20.0 followed by the Duncan Test.

Result

Egg white index

Table 1. Mean and standard deviation of quail egg white index for 7 days

Treatment	Egg white index
P0	$0.0940^{a} \pm 0.0076$
P1	$0.0890^{a} \pm 0.0107$
P2	$0.0990^{a} \pm 0.0073$
P3	$0.1016^{a} \pm 0.0112$

Note: The same superscript in the same column indicates there is no significant difference (p>0.05).

The average egg white index of quail for each treatment during the research is presented in Table 1. The average egg white index of the four types of treatment and five replications during the research was P0 0.09400; P1 0.08900; P2 0.09900; P3 0.10160 which ranges from 0.08900 to 0.10160. The results of the Analysis of Variance (ANOVA) showed that there was no significant difference in the feed treatment given (p>0.05) on the egg white index value.

Egg yolk index

Table 2. Average and standard deviation of quail egg yolk index for 7 days

Treatment	Egg yolk index
P0	$0.3360^{a} \pm 0.0167$
P1	$0.3340^{a} \pm 0.0114$
P2	$0.3580^{a} \pm 0.0192$
P3	$0.3600^{a} \pm 0.0234$

Note: The same superscript in the same column indicates there is no significant difference (p>0.05).

The average egg yolk index for quail for each treatment during the study is presented in table 2. The average egg yolk index for the four types of treatment and five replications during the study was P0 0.3360; P1 0.3340; P2 0.3580; P3 0.3600 which ranges from 0.3340 to 0.3600. The results of the ANOVA showed that there was no significant difference in the feed treatment given (p>0.05) on the egg yolk index value.

Haugh unit

Table 3. Average and standard deviation of haugh unit of quail for 7 days

Treatment	Haugh unit
P0	$85.3560^{ab} \pm 1.8834$
P1	$84.8807^{a} \pm 2.8464$
P2	$86.6729^{ab} \pm 1.2774$
P3	$87.9219^{b} \pm 1.7824$

Note: Different superscripts in the same column indicate a significant difference (p<0.05).

The average Haugh Unit value for quail for each treatment during the study is presented in table 3. The average Haugh Unit value for each treatment ranged from 84.88–87.92. From the results of the Analysis of Variance (ANOVA), it can be seen that treatment P1 is significantly different from P3. Meanwhile, P0 and P2 were not significantly different from all treatments. This means that there is no significant difference (p>0.05) but it can maintain the Haugh Unit of Japanese quail (*Coturnix coturnix japonica*).

Discussion

Egg white index

New eggs have an egg white index between 0.050-0.174 but usually ranges from 0.090-0.120. The average value of the egg white index taken during the 7 days in the last week of treatment showed that there were no significant differences between the four treatments. The egg white index value P0 is 0.09400; P1 is 0.08900, P2 is 0.09900; P3 is 0.10160.

The average egg white index obtained in this study is considered good, ranging from 0.08 - 0.10, in accordance with the opinion (Ademola *et al*., 2023) that a good egg white index is between 0.05-0.17. According to the ANOVA results, the egg white index in the four treatments showed insignificant results.

The quality of the egg white largely depends on the amount of ovumucin secreted by the magnum, because in the magnum albumen is secreted which is rich in ovumucin as much as 50-60% of the total egg white (Da Silva *et al*., 2015). Ovumucin is an egg white protein associated with a gel structure. Ovumucin is the main ingredient that determines the height of egg white and the formation of ovumucin depends on protein consumption (Omana *et al*., 2010).

According to Li *et al*. (2021), the egg white is made from a clear protein mass in the form of a thick and thin soluble dispersion which is arranged in layers based on differences in viscosity. The egg white index may decrease during storage, due to the breakdown of ovomucin. Protein in feed will have an influence on the egg white index, because the egg white index itself is influenced by the height of the thick egg white and its diameter (Wang *et al*., 2015). The thicker the egg white, the higher the egg white index. A high egg white index can be interpreted as a higher source of protein in the feed consumed (Matsuoka and Sugano, 2022).

The protein content in feed at P0 was 19.69%, P1 was 20.39%, P2 was 21.09% and P3 was 21.78%, which shows that the protein content of each treatment was not much different from the control treatment, namely P0. This could be the reason why the quail egg white index is not significantly different. Having results that were not significantly different, milkfish (*Chanos chanos*) waste flour was able to maintain the egg white index of Japanese quail (*Coturnix coturnix japonica*). This has advantages for farmers because milkfish waste meal is an economical material with affordable costs but has good quality.

Egg yolk index

The egg yolk index ranges from 0.33-0.52 with an average of 0.42 in new eggs. The average value of the egg yolk index taken for 7 days in the last week of treatment showed that there were no significant differences between the four treatments. The egg yolk index value P0 is 0.3360; P1 is 0.3340; P2 is 0.3580; P3 is 0.3600. This shows that all treatments have an egg yolk index in the good category.

Tomaszewska *et al.* (2021) said that the standard index for bad egg yolks has an average value of 0.22, while the index value for good egg yolks has an average of 0.39 and 0.45. Navara *et al.* (2023) also said that the decrease in the egg yolk index value was probably caused by a decrease in feed quality, especially the crude protein content in the treated feed.

The decreasing egg yolk index value can be caused by decreasing feed quality, especially the protein content in the feed (Mahfudz *et al*., 2018). The high egg yolk index value is influenced by the protein and fat content in the feed which functions as a mediator in the egg formation process. The function of protein and fat is to maintain the viscosity of the egg, especially in the khalaza, which helps the yolk remain in the middle and also forms a strong vitelline membrane (egg yolk covering) (Matsuoka and Sugano, 2022).

Widjastuti (2009) in research on the effect of giving papaya leaf flour up to a limit of 10% on egg quality did not make a real difference to the egg yolk index because the eggs were already at a good yolk index, so they did not produce real results. The size of yellow both in height and width is influenced by storage time. Anene *et al*. (2020) said that the quality of the egg yolk index is influenced by storage factors, age, molting, poultry strain, feed nutrition and disease.

The protein content in the feed shows that the protein content of P1, P2, and P3 is not much different from the control treatment, namely P0. This could be the reason why the quail egg yolk index is not significantly different. Apart from that, the egg yolk index produced in this study was in the good category. Based on the results of the analysis above, it can be concluded that commercial feed substituted with milkfish waste meal (*Chanos chanos*) is able to maintain the egg yolk index of Japanese quail (*Coturnix coturnix japonica*).

Haugh unit

The haugh unit value is a value that is used as a basis for determining or benchmarking the quality value of egg quality. The haugh unit is also defined as a unit used to determine the freshness of eggs. The haugh unit value is related to egg weight (grams) and albumen height (mm). The average haugh unit value for each treatment ranged from 84.88 – 87.92, so the average haugh unit value during the study was classified as AA (best) quality. New eggs have a haugh unit value of 100, good quality eggs have a haugh unit value of 75, and damaged eggs have a haugh unit value below 50 (Eke *et al*., 2013). This is also in accordance with the opinion (Liu *et al*., 2017) that determining egg quality based on the United State Department of Agriculture (USDA) standards for eggs that have a haugh unit value of more than 72 is included in AA quality.

The haugh unit value depends on the egg weight and albumen thickness. According to Da Nóbrega *et al*. (2022) the shape of the egg is an expression of the protein content of the feed. Feed protein will affect the quality of the egg interior, which can then affect the egg haugh unit.

Based on table 3, it shows that the haugh units given milkfish (*Chanos chanos*) waste flour showed no significant differences ($p>0.05$). Treatment P1 produces lower haugh units compared to P0, P2, and P3 as well as treatment P1 which is different from P3. This could be caused by differences in albumen height in each treatment. According to Obianwuna *et al*. (2022) stated that there is a positive correlation between the albumin value and the haugh unit value, namely the higher the albumin value, the higher the haugh unit value produced. This can also be caused by other factors that influence the haugh unit value, such as the length of egg storage. The longer the egg is stored, the haugh unit value will decrease and the haugh unit value will decrease with increasing age of the chicken (Jones and Musgrove, 2005).

According to Roberts (2004) stated that factors that can influence the haugh unit value are albumin height, feed nutrition, protein intake and egg weight. The low haugh unit value in the treatment is thought to be caused by the egg storage process being too long before the analysis process. This is what causes the real differences in P1 and P3. However, due to the existence of P0, it is not significantly different from P1 or P3. So it can be concluded that the substitution of commercial feed with milkfish (*Chanos chanos*) waste meal for the haugh unit of Japanese quail is not significantly different but can maintain and produce a haugh unit that is relatively the same as 100% commercial feed. Based on the protein content in the feed, it shows that the protein content of P1, P2, and P3 is not much different from the control treatment, namely P0. This could be the reason why the haugh units of quail are not significantly different. Apart from that, the haugh units produced in this research are in the good category.

Conclusion

Based on the research results, it can be concluded that substitution of commercial feed with milkfish waste meal (*Chanos chanos*) at 2%, 4%, and 6% can maintain the egg white index, egg yolk index, and haugh unit of Japanese quail.

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