

SAPU-SAPU FISH (*Hyposarcus pardalis*) AS A SINGLE PROTEIN SOURCE FOR LAYING MOJOSARI DUCKS

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ABSTRAK

Penelitian ini dilakukan untuk mengevaluasi bentuk penyajian dan level optimum ikan sapu-sapu (ISS) sebagai sumber protein tunggal untuk komponen pakan itik Mojosari yang dipelihara pada skala kecil. Sebanyak 180 ekor itik petelur umur 24 minggu diberi pakan ISS bentuk kering sinar matahari dan giling segar dengan tiga level (10,20 dan 30%) dari umur 24 sampai 32 minggu. Pakan diformula mengandung protein 105,1; 141,5 dan 177,9 g/kg dengan metabolisme energi 3078; 3065 dan 3052 kkal/kg pakan. Parameter yang diukur adalah performan produksi dan kualitas telur. Bentuk penyajian ISS berpengaruh sangat nyata ($P < 0.0001$) terhadap konsumsi pakan, produksi telur, konversi pakan, berat massa telur, dan jumlah telur kecuali bobot badan akhir. Tidak ada pengaruh nyata ($P > 0.05$) terhadap semua parameter produksi yang diukur kecuali konsumsi pakan dan bobot badan akhir. Bentuk penyajian dan level ISS menunjukkan interaksi ($P < 0.05$) terhadap bobot telur dan bobot badan. Performan dan kualitas telur rendah pada itik yang diberi ISS kering. Itik lokal dapat dinyatakan memerlukan 20% ISS sebagai sumber protein tunggal untuk produksi telur maksimum (41.2%) dengan jumlah telur per minggu (3.1 butir/ekor/minggu) selama 8 minggu pemeliharaan. Kualitas telur lebih baik dengan menggunakan ISS segar. Namun, dengan teknik pengolahan yang baik, ISS kering mempunyai potensi seperti tepung ikan konvensional untuk itik petelur.

Kata kunci: produksi dan kualitas telur; ikan sapu-sapu, itik Mojosari

ABSTRACT

The present study was conducted to evaluate the optimum level of dietary inclusion and the form of feeding sapu-sapu fish (SSF) as a single protein source for feed components of small holder Mojosari duck farming. A total of 180 twenty four wk-old laying ducks were fed with two forms (sun-dried and ground-fresh) and three levels of SSF (10, 20 and 30%) from 24 to 32 wk of age. Experimental diets were formulated containing 105.1; 141.5 and 177.9 g/kg crude protein and 3078; 3065 and 3052 kcal metabolizable energy (ME) /kg diet. Production performance and egg quality were measured. The form of SSF had a significant effect ($P < 0.0001$) on feed intake, egg production, feed conversion, egg mass and egg number except final body weight. No significant effects ($P > 0.05$) were found on all of the performance parameters measured due to feeding levels of SSF except feed intake and final body weight. The interaction of form and feeding level was significant ($P < 0.05$) on egg and body weights. Low performance and egg quality were observed in the birds fed a diet containing the dried SSF. It can be suggested that local ducks required 20% SSF as a single protein source for maximum egg production (41.2%) and total egg number per wk (3.1 eggs/bird/wk) during 8 wk of rearing period. Egg quality can be improved by feeding the fresh SSF. However, due to be sufficiently better processing technique, the dried SSF would be potential to replace the common fish for laying ducks.

Keywords: egg production and quality, sapu-sapu fish, Mojosari duck

INTRODUCTION

Common fish meal (CFM) have been known to be an excellent protein source for poultry because of its complete essential amino acids although it has low fat and calorie contents (Wimalasena and Jayasuriya, 1996; Thongwittaya, 2007). Until the present time, CFM is too expensive and unaffordable for most small scale farmers. Some studies have been carried out to replace fish meal in part or complete substitution with other protein sources such as groundnut cake and blood meal (Onwudike, 1981), shrimp waste (Dong *et al.*, 2005), grasshopper (Hassan *et al.*, 2009), shrimps and marine waste (Aktar *et al.*, 2011), and sesame seed cake (Falayi *et al.*, 2013). However, such efforts were not significantly successful, due to the level-dependent of substitution (Aktar *et al.*, 2011) and also other protein sources used in the feed formulation.

Mojosari ducks are one of the local laying waterfowl breeds in Indonesia and very popular breed for their high egg production. However, because of the high commercial feed cost, most of local farmers fed their ducks with the alternative animal protein source such as ground fresh sapu-sapu fish (SSF) (*Hyposarcus pardalis*) as a substitution for fish meal. Based on our proximate analysis using the procedure of AOAC (1990), dry matter, crude protein, ether extract, crude fibre, and ash of SSF were 96.28, 42.49, 14.38, 10.99, and 26.66% respectively. Whilst fish meal according to NRC (1994), depending on the variety of fish, contains dry matter, crude protein, ether extract, and crude fiber in the range of 92.0-93.0, 60.05-64.2, 5.0-10.0, 0.7-1.0% respectively and no ash information was available. SSF is a fresh water fish and easily available grows in the polluted environments of river water (Roosmini *et al.*, 2006).

A preliminary study conducted by the author revealed that production performance of layer ducks during the second laying production period was relatively high when a combination of ground fresh SSF with rice bran and yellow corn was fed. However, this ground fish is a highly perishable and rapidly spoiled make it possible to be easily broken by the microorganisms. When an excessive feeding practice was applied, it will create odor problems. Therefore, the present study was undertaken to assess different forms and levels of SSF on productive performance and egg quality of laying Mojosari ducks.

MATERIALS AND METHODS

Material and Management

A total of 180 24-wk-old laying Mojosari ducks were obtained from the local breeder and distributed into a completely randomized design in a 2x3 factorial arrangement. They were then weighed, wing-banded individually and reared in grouped-housed in an intensively ban from bamboo. Two forms (ground fresh and sun dried) and three levels of sapu-sapu fish (10, 20 and 30%) were formulated as the treatment diets. Each treatment was replicated in six times with 5 birds per replicate. Diets were based on yellow corn and rice bran (Table 1) and fed from 24 to 32 wk of age. Feeding method was restricted to 190 g/bird/d and provided twice a day (6.00 am and 5.00 pm) to avoid the over spilling feed. The diets were provided in a slurry form. Spillage of the feed was calculated by weighing and drying the remaining feed on the feeder and drinking water to correct the feed intake. Each pen was made from bamboo and had an area of 1 x 0.85m for the floor space with rice hulls as the litter. The pens were equipped with one rounded plastic feeders with 20 cm in diameter. Routine management practices such as health and disease control programs were applied. The ducks were again individually weighed on the last day of the study.

Parameters

The data on feed intake, egg production and egg weight were recorded daily. Feed conversion ratio (g feed/g egg) and egg mass (g/hen/day) were calculated. The external and internal qualities of eggs laid by ducks were measured on wk 7, and 8 of the experimental production period for two consecutive days. A total number of 288 eggs (72 eggs per collection) were taken and broken out on a clean Petri dish. Shell thickness, shell weight, albumen weight and albumen height, yolk weight and yolk height were analyzed and then yolk color was measured against the Roche Yolk Color Fan scale (RYCF) as a tool for a standard colors ranging from 1 (the lightest) to 15 (the darkest). This work was carried out at the Laboratory of Animal Product Processing Technology- Faculty of Animal Science, Mataram University.

Statistical Analysis

Data were analysed by ANOVA according to the General Linear Model procedure of SAS software (SAS, 1999) for a completely

Table 1. Ingredient and Nutrient Composition (g/kg) of Experimental Diets

Ingredient g kg ⁻¹	Dietary treatment		
	T1	T2	T3
Rice bran (RB)	600	500	400
Yellow corn (YC)	300	300	300
Sapu-sapu fish (SSF)	100	200	300
Total	1,000	1,000	1,000
Calculated nutrients			
Metabolizable energy, kcal kg ⁻¹	3,078	3,065	3,052
Crude protein, g kg ⁻¹	105.10	141.50	177.90
Crude fiber, g kg ⁻¹	135.50	119.00	100.90
Ether extract, g kg ⁻¹	41.20	52.60	63.90
Ash, g kg ⁻¹	141.70	150.10	158.60
Calcium, g kg ⁻¹	1.07	1.84	2.62
Available phosphorus, g kg ⁻¹	0.53	0.59	0.66

No vitamin and mineral added

T1: 10% SSF; T2:20% SSF; T3= 30% SSF

randomized design with a factorial arrangement. The independent variables were form and levels of SSF. The differences between the means of groups were identified by Tukey's Test with the significant levels of $P < 0.05$.

RESULTS AND DISCUSSION

Production Performance

Production performance (Table 2) showed that the form had a significant effect ($P < 0.0001$) on all parameter measured except final body weight. Whilst the levels of SSF did not affect ($P > 0.05$) bird's performance except feed intake and body weight. There was a significant interaction ($P < 0.05$) between the two evaluated factors only on egg weight and body weight.

Overall, the birds consuming a diet containing the dried SSF resulted in low production performance. Lower feed intake, egg production, egg weight, total egg number, egg mass and poor FCR of the birds fed with the dried SSF than that of the fresh. This may be related to the natural feeding habit of ducks with the fresh and wet feeds. In addition, imperfect sun-drying in this study could also be responsible to the low production performance. A study of Akintola *et al.* (2013) showed the lowest amino acid in sun-dried process of giant tiger shrimp. Sun-dried fish was responsible to the fat loss (Akinwumi *et al.*, 2011), protein loss (Jeyasanta *et al.*, 2014) and more susceptible to microbial invasion (Akinwumi *et al.*, 2011) due to improper drying.

The effect of different levels of SSF on feed intake and body weight was significant but other parameters numerically showed higher values in higher ISS levels. The birds fed higher SSF (30%) which provide the higher dietary protein (177.9 g/kg) showed significantly the lower feed intake (122.6 g/bird/d) than the higher feed intake values of 130.7, 137.1 g/bird/d for birds on lower SSF (20% and 10%) diets. However, increasing SSF levels from 10 to 30% increased protein intake from 15.2 to 24.3 g/bird/d (Table 3) and improved body weight inconsistently. The highest values of body weight was on the 30% SSF (1.53 kg/bird). In contrast, Bunchasak *et al.* (2005) showed that hens fed with the 16% CP diet had higher feed intake than the 14% CP diet. Since the present study formulated the high protein diet with low ME whilst Bunchasak *et al.* (2005) used a high ME diet, birds fed on high protein diet, the voluntary feed intake is solely triggered by the low energy content in the diet.

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Table 2. The Effect of Forms and Levels of SSF on Productive Performance of Mojosari Ducks From 24 to 32 Wk of Age

SSF Form	SSF Level (%)	Feed Intake (g)	Egg Production (%)	FCR (g feed/g egg)	Egg Weight (g)	Total Egg Number/Bird/wk (eggs)	Egg Mass (g/bird/d)	Body Weight (gram)
Dried		121.9 ^b	29.0 ^b	6.807 ^a	55.6 ^b	2.4 ^b	16.30 ^b	1456
Fresh		138.4 ^a	50.7 ^a	4.223 ^b	62.0 ^a	3.5 ^a	31.48 ^a	1479
Pooled SEM		1.5	1.87	0.284	1.19	0.11	1.20	23.3
	T1	137.1 ^a	38.3	5.865	57.3	2.8	21.98	1453 ^b
	T2	130.7 ^b	41.2	5.860	58.3	3.1	24.65	1420 ^b
	T3	122.6 ^c	40.4	4.820	60.8	2.9	25.05	1529 ^a
Pooled SEM		1.9	2.29	0.348	2.07	0.34	1.48	28.5
Dried	T1	126.9	29.0	6.822	57.2 ^a	2.4	16.56	1532 ^{ab}
	T2	121.2	27.3	7.584	53.7 ^b	2.3	14.70	1382 ^b
	T3	117.6	31.3	6.015	55.9 ^b	2.6	17.63	1453 ^{ab}
Fresh	T1	147.3	47.6	4.907	57.4 ^a	3.3	27.40	1375 ^b
	T2	140.3	55.1	4.136	62.8 ^a	3.8	34.60	1458 ^{ab}
	T3	127.3	49.3	3.625	65.7 ^a	3.3	32.46	1604 ^a
Pooled SEM		2.3	3.2	0.492	1.8	0.19	2.09	40.4
Main Effect								
Form		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	NS
ISS level		<0.0001	NS	NS	NS	NS	NS	0.0263
Form x Level		NS	NS	NS	0.0367	NS	NS	<0.01

^{a-c} Means within a row with no common superscript differ significantly (P<0.05). SEM: standard error of mean. Ducks fed RB 60%, YC 30%, SSF 10% (T1); ducks fed RB 50%, YC 30%, SSF 20% (T2); ducks fed RB 40%, YC 30%, SSF 30% (T3), RB:Rice Bran, YC: Yellow Corn, SSF= Sapu-sapu Fish. NS= Not Significant

Increasing SSF levels did not affect significantly (P>0.05) on egg production. The 20% SSF tended to have the higher egg production (41.2%) than the 30% SSF (38.3%) with the total egg number/bird/wk was 3.1 eggs. It means that the level protein requirement had been reached with the 20% SSF containing 14.15% CP which was the precise requirements for laying Mojosari ducks. The effect of dietary protein on egg production in this study was consistent with

Junqueira *et al.* (2006) who reported higher protein levels did not have any effect on bird performance.

The interaction of SSF form and levels influenced egg weight and body weight indicated that increased feed intake significantly (P<0.05) due to SSF fresh and increased protein intake with increased SSF levels (Table 3) which resulted in increased egg weight and body weight. Conversely, the dried SSF reduced feed intake

Table 3. The Effect of Forms and Levels of SSF on Nutrient Intake of Mojosari Ducks From 24 to 32 Wk. of Age*

SSF Form	SSF Level (%)	Energy Intake (kcal/bird/d)	Protein Intake (g/ bird/d)	Crude Fiber Intake (g/ bird/d)	Ether Extract Intake (g/ bird/d)	Ca Intake (g)
Dried		373 ^b	18.4 ^b	15.5 ^b	6.37 ^b	2.39 ^b
Fresh		424 ^a	21.4 ^a	18.0 ^a	7.20 ^a	2.78 ^a
Pooled SEM		3.9	0.22	0.19	0.08	0.03
	T1	422 ^a	15.2 ^c	19.5 ^a	5.65 ^c	1.546 ^c
	T2	400 ^b	20.2 ^b	17.0 ^b	6.87 ^b	2.640 ^b
	T3	374 ^c	24.3 ^a	13.8 ^c	7.83 ^a	3.587 ^a
Pooled SEM		4.8	0.27	0.24	0.09	0.03
Dried	T1	390	14.2	18.3	5.2	1.448 ^d
	T2	371	18.2	15.3	6.3	2.377 ^c
	T3	358	22.7	12.9	7.5	3.354 ^a
Fresh	T1	453	16.1	20.8	6.0	1.645 ^d
	T2	430	22.3	18.7	7.3	2.903 ^b
	T3	389	25.9	14.7	8.1	3.820 ^a
Pooled SEM		6.8	0.39	0.31	0.13	0.053
Main Effect						
Form		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Level		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Form x Level		NS	NS	NS	NS	0.0204

^{a-d} Means within a row with no common superscript differ significantly (P<0.05); SEM: standard error of mean. Ducks fed RB 60%, YC 30%, SSF 10% (T1); ducks fed RB 50%, YC 30%, SSF 20% (T2); ducks fed RB 40%, YC 30%, SSF 30% (T3), RB:Rice Bran, YC: Yellow Corn; SSF= Sapu-Sapu Fish.

*Calculated from feed composition is shown in Table 1 and 2. NS= Not Significant

then reduced body weight which reduced egg weight. Lacin *et al.* (2008) noted that there was egg weight increased as body weight increased.

In terms of feed conversion, the inclusion levels of SSF in the diet did not affect FCR significantly. Feed conversion ratio was significantly improved from 6.807 to 4.223 with the fresh SSF. The fresh SSF improved FCR because feed intake increased significantly (138.4 g/d) with higher egg mass (31.48 g/bird per day) compared to the dried SSF with lower feed intake

(121.9 g/bird per day) and egg mass (16.30 g/bird per day). This result was consistent with that of Gunawardana *et al.* (2008) who indicated that a significant increase in protein and energy diets, improved feed conversion significantly as egg weight and production increased significantly. Egg weight and egg production responded in a linear manner to balanced dietary protein level (Shim *et al.*, 2013). This could be achieved in the balance of amino acids of the protein diet which is available from the SSF fresh.

Egg Quality Assessment

The results of egg quality parameters measured at 31 and 32 wk of age are depicted in Table 4. It appears that there was no effects of the form of SSF on shell weight, albumen weight, and albumen height but it affected shell thickness, yolk weight, and yolk height and yolk color.

Levels of SSF had no significant effect on all egg quality parameters measured except the shell thickness. There was no interaction between forms and levels of SSF on egg quality parameters. The higher shell thickness observed at

higher SSF could be due to the higher Ca intake (Table 3). Birds receiving the 30% SSF provided 2.62% dietary Ca with the average Ca intake 3.587 g/bird/d. This finding closely agreed with Chen and Shen (1989) who reported that for maximum shell quality, 3% dietary calcium levels was sufficient for laying ducks.

There was no significant effect of SSF forms and levels and their interaction ($P>0.05$) on albumen weight and albumen height (Table 4). Thus increasing SSF increased dietary protein levels did not affect on albumen parameters. This

Table 4. Egg Quality of Laying Ducks Fed with Different Forms and Sapu-sapu Fish (SSF) Dietary Levels From 24 to 32 Weeks of Age

SSF Form	SSF Level (%)	Shell Weight (g)	Shell Thickness (mm)	Albumen Weight (g)	Albumen Height (mm)	Yolk Weight (g)	Yolk Height (mm)	Yolk Color RCF
Dried		7.35	0.393 ^b	27.58	8.79	20.60 ^b	19.06 ^b	7.50 ^b
Fresh		7.56	0.496 ^a	27.83	10.42	24.14 ^a	22.25 ^a	9.84 ^a
Pooled SEM		0.25	0.012	1.24	0.58	0.81	1.05	0.34
	T1	7.44	0.417 ^b	27.09	9.46	21.54	20.65	9.00
	T2	7.37	0.436 ^{ab}	27.50	8.47	23.05	21.30	8.00
	T3	7.55	0.480 ^a	28.53	10.89	22.53	20.02	9.16
Pooled SEM		0.30	0.015	1.52	0.72	0.99	1.29	0.42
Dried	T1	7.00	0.366	29.50	9.25	21.28	18.62	7.66
	T2	7.81	0.356	26.85	8.84	19.68	18.58	7.00
	T3	7.88	0.456	27.15	13.18	20.85	19.99	7.83
Fresh	T1	7.88	0.468	24.68	9.66	21.80	22.68	10.33
	T2	6.93	0.516	28.16	8.10	26.41	24.02	9.00
	T3	7.23	0.503	29.91	8.61	24.21	20.05	10.50
Pooled SEM		0.43	0.022	2.15	1.01	1.40	1.82	0.59
Main Effect								
Form		NS	<0.0001	NS	NS	0.004	0.041	<0.0001
Level		NS	0.0264	NS	NS	NS	NS	NS
Form x Level		NS	NS	NS	NS	NS	NS	NS

^{a-c} Means within a row with no common superscript differ significantly ($P<0.05$). SEM: standard error of mean. Ducks fed RB 60%, YC 30%, SSF 10% (T1); ducks fed RB 50%, YC 30%, SSF 20% (T2); ducks fed RB 40%, YC 30%, SSF 30% (T3); RCF (Roche Color Fan), RB:Rice Bran, YC: Yellow Corn; SSF= Sapu-Sapu Fish, NS= Not Significant

is in agreement with that of Anwar *et al.* (2015) who found that albumen weight and albumen were not affected by dietary protein levels.

In relation to yolk parameters, the fresh of SSF significantly affect ($P < 0.05$) on yolk weight, yolk height and yolk color. However, the levels of SSF did not affect all these characteristics. There was no interaction between the SSF form and levels. Yolk color was measured as an indicator of egg quality and provided for desirable consumer preferences. With similar levels of yellow corn (30%) imposed in this study (Table 2), yolk color reached 9.84 and 7.5 RYCF in fresh and dried SSF respectively (Table 4). Corn has been known as carotenoid and xanthophyll sources to improve yolk pigmentation. In a diet containing corn, pigmentation in egg yolk was in linear with the levels of corn portion used in the diet (Ghazvinian *et al.*, 2011; Kljak *et al.*, 2012). Rashid *et al.* (2004) used 58 and 67.5% corn in the diet, yolk color score obtained were 8.58 ± 1.70 and 5.9 ± 1.81 . Laganá *et al.* (2011) reported feeding 32.24% corn in sorghum and soybean meal based diet without pigment supplementation, yolk color was from 6.5 to 4.0 from day 0 to 28 of observation. As laying birds cannot synthesize egg yolk pigments, egg yolk color strongly depends on the fat-soluble pigments in the diets fed (Gunawardana *et al.*, 2008; Kljak *et al.*, 2012). Increasing egg yolk color was influenced by the added dietary fat and xanthophylls as the major color agent is highly fat soluble (Gunawardana *et al.*, 2008). However, it might be possible that high carotenoid contents of corn were more dominant to control the pigmentation than the energy levels (Moghaddam *et al.*, 2012). In our study, since the fat content of the fresh fish was higher than that of the dried and SSF fat content was also higher than common fish meal (NRC, 1994), increasing the fat content in the diet means increasing xanthophylls may be deposited.

CONCLUSION

The current study demonstrate the potential SSF as a single protein source in rice bran and yellow corn based diets to replace common fish meal for laying Mojosari ducks which is evidenced by improving egg production. The fresh SSF form inclusion at the level of 20% can be used to provide the highest egg production. The high inclusion of fresh SSF in the corn-rice bran based diet is possible to improve egg yolk pigmentation and shell thickness

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