Utilization of Sago Waste Fermented by *Neurospora* sp. as Alternative Corn Substitution on Laying Duck Production

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(received 03-01-2024, revised 22-04-2024, accepted 02-05-2024)

ABSTRAK

Matitaputty PR, Nurfaizin, Ralahalu TN, da Costa MA. 2024. Penggunaan limbah sagu yang difermentasi dengan *Neurospora* sp. sebagai alternatif pengganti jagung terhadap produksi itik petelur. JITV 29(2):91-96. DOI:http://dx.doi.org/10.14334/jitv.v29i2.3216.

Persediaan jagung sebagai sumber energi dalam ransum ternak di wilayah Maluku masih memiliki kendala sehinga perlu dicari penggantinya. Salah satu pakan alternatif yaitu adalah penggunaan ampas sagu yang difermentasi dengan *Neurospora* sp. Tujuan pengkajian ini mengetahui pengaruh penggunaan ampas sagu yang difermentasi *Neurospora* sp. sebagai pakan alternatif terhadap produktivitas itik petelur. Materi yang digunakan adalah itik lokal betina Maluku sejumlah 120 ekor umur umur 22 minggu yang dibagi menjadi 4 perlakuan. Masing-masing perlakuan mendapat 5 ulangan yang terdiri dari 6 ekor pada setiap unit perlakuan. Empat perlakuan yang diberikan yaitu T0 (penggunaan fermentasi ampas sagu 0% dalam ransum), T1 (10 % dalam ransum), T2 (20 % dalam ransum), T3 (30 % dalam ransum), T4 (40 % dalam ransum) dilakukan selama 14 minggu. Berdasarkan penelitian dihasilkan penggunaan pakan ampas sagu terfermentasi *Neurospora* sp. terdapat beda (P<0,05) pada konsumsi, produksi telur dan konversi ransum pada perlakuan T0, T1, T2 dan T3 terhadap T4., Sedangkan pada kualitas telur yang meliputi berat telur, kandungan karoten kuning telur; dan bau tidak berbeda nyata. Kesimpulan dari pengkajian ini adalah penggunaan Ampas sagu yang difermentasi dengan *Neurospora* sp. hinga level maksimal 30 % mampu mensubstitusi penggunaan jagung dalam ransum tanpa mengurangi produktivitas itik.

Kata Kunci: Itik Petelur, *Neurospora* sp., Ampas Sagu

ABSTRACT

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The corn stock as a feed energy metabolism source in the Moluccas region is still an obstacle, so there is a need to find a substitution. One of the alternative feeds used is sago waste fermented by *Neurospora* sp. The study aimed to determine the effect of sago waste fermented by *Neurospora* sp. as alternative feed productive for laying ducks. The material used was 120 local Moluccas laying ducks aged 22 weeks divided into 5 treatments. Each treatment consisted of 5 replications of 6 laying ducks in each treatment unit. There were five dietary treatments with the inclusion of fermented sago weste: T0 (0%), T1 (10%), T2 (20%), T3 (30%), and T4 (40%). A feeding trial was carried out for 16 weeks. Results showed that the treatments using fermented sago waste by *Neurospora* sp. significantly affected (P<0.05) consumption, production, and feed conversion efficiency. At the same time, egg quality regarding egg weight, yolk carotene content, and odor were not significantly influenced. In conclusion, the maximum level of the use of *Neurospora* sp. fermented sago was 30% in feed without reducing the general performance of the ducks.

Key Words: Laying Duck, *Neurospora* sp., Sago Waste

INTRODUCTION

Duck is one of the poultry productions that has been reared traditionally. Products like eggs benefit food and income (Daud et al. 2020). Optimal egg production can be achieved by laying ducks under sufficient nutritious feed. There needs to be more than corn as raw material stocks in the Moluccas region to maintain duck farming. It is imported, making the prices relatively expensive. Furthermore, most of the duck business problems in Moluccas are due to low productivity, as farmers need to feed ducks properly according to optimal nutrient requirements.

However, corn used as a duck's energy source can be substituted with another local feed ingredient. A considerable stock of cheaper sago waste is available

close to the farms. However, there have been problems with high levels of crude fiber of 9.22-10.50% and low crude protein of 0.92-1.01% (Uhi 2018). Fermentation technology using *Neurospora* sp. is one solution to reduce high crude fiber feed (Adli et al. 2021). *Neurospora* sp. produces cellulase enzymes that degrades crude fiber (Kanti dan Sudiana. 2016). *Neurospora* sp. is usually used to make fermented sago waste called "oncom," one of the traditional foods in Indonesia, which is also found in Waimital Village, Seram Western District, Moluccas Province. Orange conidia is a unique characteristic of *Neurospora* sp. That can be seen in the surface of "oncom" (Kenyamu et al. 2014; Nurfaizin and Matitaputty 2016; Munasik et al 2023) The substrate fermented by *Neurospora* sp. can increase crude protein and carotene content. It was reported that feed containing fermented sago waste could effectively maintain the body weight of growing ducks (Uhi 2018).

The fermented sago waste contained crude protein 4.56-4.58%, crude fiber 5.49-6.25%, extract ether 0.71-0.73%, and metabolizable energy 3,508-3,860 kcal/kg (Uhi 2018). Carotenoids are effective as antioxidants, preventing free radical oxidation and increasing the carotene in the yolk (Bovšková, et al 2014; Kenyamu, et al. 2014)

Based on the information above, it is hypothesized that sago waste fermented by *Neurospora* sp. can be compatible with duck feed. The study aimed to determine the effect of sago waste fermented by *Neurospora* sp. on the productivity of local laying ducks.

MATERIALS AND METHODS

Material

This experiment used 120 local laying ducks, aged 22 weeks and with an average body weight of 1296,50 g/head. The ducks were divided into 4 dietary treatments, with 5 replicates per treatment. Each replicate consisted of 6 birds kept intensively in a 1 m x 1 m cage for 14 weeks. Diets (Table 1) and drinking water were offered *ad libitum*.

Neurospora sp. fermentation of sago waste

Two kilograms of sago waste were mixed with 600 ml of tofu waste and water until the percentage of water content was 60% and stirred until smoothly homogenous. Then, the mixed material was steamed at 100ºC for about 45 minutes and cooled at room temperature. Nine percent of the inoculum of *Neurospora* sp. was added and stirred smoothly and homogeneously. The material was then incubated for 10 days. The fermentation product was harvested, dried in the sun and grind, and stored for further utilization.

Experimental diets

The experimental diets were analyzed proximately for dry matter, crude protein, crude fiber, crude fat, non-nitrogen-free extract, ash, Ca, and P at the Indonesian Research Institute for Animal Production Laboratory at Bogor Regency. For total carotene content, the diet samples were analyzed at the Indonesian Agricultural Postharvest Research and Development Laboratory in Bogor City, according to (AOAC 2009).

Experimental design

The experiment was conducted using a completely randomized design (CRD) with five treatments and four replicates consisting of six birds each. The treatments are T0=Control (farmer diet), T1=10 % Sago Waste fermented by *Neurospora* sp. used in the diet, T2=20 % Sago Waste fermented by *Neurospora* sp. used in the diet, T3=30 % Sago Waste fermented by *Neurospora* sp. used in the diet, and T4=40 % Sago Waste fermented by *Neurospora* sp. used in the diet.

Measurements of variables

Duck day production, feed consumption, and feed conversion were measured during the experimental treatment observation period of 14 weeks. Duck day production was calculated by the number of eggs produced divided by the number of ducks on the same day. Feed given and left was recorded to calculate daily feed intake. The feed conversion ratio was calculated by dividing the total feed weight consumed by the total egg weight on the same day. The egg yolk color index was observed by comparing egg yolk color using the Roche Egg Yolk Color Fan (Bovšková et al. 2014; Pane et al. 2023). Spectrophotometric methods with isooctane solvent and observed absorbance of light with a wavelength of 450 nm were used to determine the total carotene content of yolk (AOAC 1990). An organoleptic test on egg odor compared to the palatability of fishy odors was conducted involving adult untrained panelists of 30 people consisting of 10 men and 20 women. Panelists rated egg odor by scaling from 1 to 5. Scale 1 was very fishy, 2 for fishy, 3 for rather fishy, 4 for less fishy, and 5 for not fishy.

Data analysis

The nutrient content of sago waste fermented by *Neurospora* sp. was analyzed descriptively. Egg production and qualitative data were analyzed using ANOVA, and any mean differences were further tested using the Duncan Test (Mattjik and Sumertajaya 2013). The values were expressed as means, and statistical significance was judged at the probability of $P<0.05$. Overall, data analysis was performed using SPSS 18 software.

Table 1. Ingredient and nutrient content of experimental diet

Ingredients	Treatment				
	T0[1]	**T1**	**T2**	**T3**	**T4**
	----------%----------				
Corn	40.00	30.00	20.00	10.00	0.00
Sago waste fermented by *Neurospora* sp, (%)	00.00	10.00	20.00	30.00	40.00
Ricebran (%)	30.00	26.00	26.00	25.00	25.00
Fish meal (%)	10.00	11.00	11.00	12.00	12.00
Coconut meal (%)	17.00	18.00	18.00	18.00	18.00
$CaCO_3$(%)	00.00	4.00	4.00	4.00	4.00
Premix (%)	3.00	1.00	1.00	1.00	1.00
Total (%)	100.00	100.00	100.00	100.00	100.00
Moisture content (%)	11.95	12.62	12.07	11.98	12.69
Crude protein (%)	19.27	19.08	19.08	19.51	19.31
Crude fiber (%)	4.61	4.33	3.42	3.93	6.89
Crude fat (%)	3.13	2.96	1.72	1.63	2.78
Gross energy (kal/Kg)	3778	3567	3625	3518	3430
Ca (%)	1.74	3.36	2.87	2.83	4.01
P (%)	0.42	0.57	0.56	0.48	0.72
Total Carotene, (%)	0.24	0.20	0.22	0.39	0.37

T0= Basal diet without fermented sago waste; T1= Diet contained 10% fermented sago waste, T2= Diet contained 20% fermented sago waste, T3= Diet contained 30% fermented sago waste, T4= Diet contained 40% fermented sago waste

RESULTS AND DISCUSSION

Nutrient content of *Neurospora* sp.-fermented sago waste

The proximate and carotene analyses are presented in Table 2. Based on the analysis, it is known that Neurospora sp. ferments sago waste products changed nutrition content, especially crude protein, crude fiber, and total carotene of feed.

Crude protein content in sago waste increased during *the Neurospora* sp. fermentation process (from 1.4% to 3.28%). After fermentation by Neurospora sp., the crude fiber content of sago waste decreased from 11.56% to 7.02%. *Neurospora* sp. improved sago waste nutrition content through fermentation, which produced protease and cellulose enzymes to improve sago waste's nutrition content. Cellulolytic enzymes break cellulose bonds of the substrate, which causes the content of crude fibers to decrease. (Li et al. 2014) reported that *Neurorospora* crassa showed protease and cellulase enzyme activity. Based on (Kanti da&n Sudiana. 2016), *Neurospora* crassa can also synthesize and secrete enzymes involved in cellulose degradation and increased protein content of material during the *Neurospora* fermentation process. *Neurospora*-fermented stuff was utilized better in animal feeds (Kanti & Sudiana 2016).

The total carotene content increased due to fermentation (from 0.033% to 0.742%). The carotene was produced during *the Neurospora* fermentation process. The color of the carotene was orange. Increased carotene caused by fermentation with *Neurospores* could synthesize geranyl diphosphate (GGDP) until it eventually became β-carotene (Gedela et al. 2015; Liu et al. 2016). *Neurospora* produces intracellular carotenoid pigments stored in conidia, which causes an orange color (Kenyamu & Mappiratu 2014). *Neurospora* is potentially used in the feed industry as it produces yellow-to-orange carotenoids (Gmoser et al. 2018).

Ducks productivity

There was no significant ($P>0.05$) effect of T0, T1, T2, and T3 dietary treatments on feed consumption, egg production, and feed conversion ratio. Treatment T4, containing 40% fermented sago waste, significantly ($P<0.5$) reduced food consumption, reduced egg production, and increased feed conversion ratio compared to ducks on T0, T1, T2, and T3.

Table 2. Nutrient Content of *Neurospora* sp. fermented sago waste

	Sago waste	Sago waste fermented by *Neurospora* sp.
Moisture Content (%)	12.30	10.34
Crude protein (%)	1.40	3.28
Crude fiber (%)	11.56	7.02
Crude fat (%)	0.25	1.19
Ash (%)	11.76	14.32
Ca (%)	0.32	0.37
P (%)	0.02	0.07
Total Carotene (%)	0.033	0.742

Table 3. The productivity of laying ducks under experimental diets

	T0[1)]	T1	T2	T3	T4
Feed Consumtion (g/day)	115.04±6.47 [b2)]	114.19±6.01 [b]	114.80±6.28 [b]	114.49±5.49 [b]	111.86±8.92 [a]
Duckday (%)	53.68±14.19[b]	54.38±14.04[b]	54.05±15.26[b]	56.55±17.61[b]	50.15±12.62[a]
Feed conversion ratio	3.65±1.05 [b]	3.61±1.14 [b]	3.66±1.26 [b]	3.53±1.41 [b]	3.95±1.09 [a]

T0= Basal diet without fermented sago waste; T1= Diet contained 10% fermented sago waste, T2= Diet contained 20% fermented sago waste; T3= Diet contained 30% fermented sago waste, T4= Diet contained 40% fermented sago waste Values on the row with difference superscripts are significantly different (P<0.05)

Feed consumption of all treatments of ducks under T0, T1, T2, and T3 were significantly different (P<0.05) from feed consumption of ducks on T4. Using 40% level sago waste fermented by *Neurospora* sp. affected decreasing duck consumption, caused by crude fiber in the T4 treatment, which is relatively high at around 6% compared to the other treatments. According to (Novieta, et al. 2023) bulky crude fiber content made the digestive tract feel full and more quickly stopped eating, so the consumption of diet decreased; according to (Zulkarnain, et al. 2017) research explained that sago waste fermented sago waste was used as an energy source in broiler chicken diet. Therefore, feedstuff, considered an energy source for poultry, must contain highly digestible carbohydrates (Sugiyono, et al. 2015).

Feeding Neurospora sp. fermented sago waste seemed to cause a slight increase in egg production but was insignificant (P>0.05). However, T3 caused the duck to produce more eggs than the duck in T4, which showed that using *Neurospora* sp. fermented sago waste at 30 % of the diet will produce good egg production. All nutrient content in the T0, T1, T2, and T3 except T4 have been capable of fulfilling nutrient requirements to produce maximal local duck egg production. According to (Otay, et al. 2014), high egg production can be obtained by feeding based on nutritional ducks' requirements. Compared to treatment with standard diets, using sago waste fermented by Neurospora sp. as an alternative feed in Maluku province did not affect laying duck production except on T4. Gunawan et al. (2015) reported a level of 5% fermentation of sago waste on a diet substituted with a commercial quail diet without decreasing egg production.

Feeding Neurospora sp. fermented sago waste at 30% (T3) provided the lowest feed conversion ratio to laying ducks. A high feed conversion ratio means that feed consumed by ducks could have been utilized more optimally for egg production. According to (Fanani, et al. 2017), The higher the feed conversion the less economical the use of the feed otherwise, the lower the conversion rate the smaller it is, the more economical it is.

Egg quality

Egg quality data as affected by feeding *Neurospora* sp. sago waste by *Neurospora* sp. Are presented in Table 4. Feeding *Neurospora* sp. fermented sago waste was not significantly affected (P>0.05). The egg weight of 54.79-56.38 g/egg was the average duck egg weight at 22-30 weeks old. Therefore, the use of *Neurospora* sp. Fermented sago waste in local duck feed was obviously no harm to egg weight. The duck egg weight was affected by many factors, such as genetics, age, and nutrition (Widiyaningrum, et al. 2016). Based on (Lupita, et al. 2019), the average local Magelang duck eggs weigh about 53,66-57.84 g/egg at the age of 20 weeks old.

Table 4. The quality of eggs as affected by experimental diets

	T0[1)]	T1	T2	T3	T4
Egg weight (g/egg)	56.38±3.43	56.26±3.44	56.27±2.82	56.17±3.18	54.79±4.22
Total carotene of yolk (ppm)	105.65±19.88	118.12±12.27	146.51±45.15	178.07±63.59	144.09±70.79
Egg yolk color index	8.38±1.11	8.31±1.48	8.25±2.14	8.31±1.10	8.27±0.49
Odor scale	3.54±0.98	3.89±0.89	3.64±1.21	3.79±1.11	3.32±0.76

T0= Basal diet without fermented sago waste; T1= Diet contained 10% fermented sago waste, T2= Diet contained 20% fermented sago waste; T3= Diet contained 30% fermented sago waste, T4= Diet contained 40% fermented sago waste

Feeding local Maluku ducks with 15% sago waste resulted in a minimum egg weight of 40g (Matitaputty & Bansi 2018).

Dietary treatment did not significantly affect the total egg yolk carotene (P>0.005). It is assumed that experimental diets contained sufficient carotene to maintain the quality of duck yolk egg. According to Mulyadi,, et al. (2017), factors that affect egg yolk color are carotenoids and other pigment substances in the diet. Pigments forming egg yolk color come from yellow feed colors like corn. Carotenoids consumed from feed and other biofortification were saved in peripheral tissues to change the orange pigment and the egg yolk. However, the quantity and quality of feed consumed would affect egg production and physical-chemical quality (Moreno, et al. 2016).

Utilization *of Neurospora* sp-fermented sago waste resulted in a good index production of egg yolk color. The egg yolk color index of duck feed dietary treatments (T0, T1, T2, T3, and T4) was not significantly affected (P>0.05). Increasing the yolk color score of the treatment will cause a preferable product and affect the chemical composition of the egg yolk. The yolk color is one of the attractions for duck egg consumers. According to Pane et al. (2023), a high egg yolk color score describes a high carotene content of the egg yolk.

The odor of duck eggs was not significantly different (P>0.05) due to all treatments. The duck eggs' odor was rather fishy (scale 3.32-3.89)—the odor was identified with the sense of smell (nose). The odor test is essential in providing an assessment of the acceptability and quality of a product. In general, the quality of duck eggs is in the range of fishy to rather fishy (Gunawan 2019). Strong fishy products would make consumers not interested in consuming the product (Qomaruddin & Afandi, 2017). The fishy odor of eggs is related to duck feed consumption (Sundari et al. 2020).

CONCLUSIONS

The *Neurospora* sp-fermented sago waste in diet effectively increased egg productivity. To some extent, the 30% *Neurospora* sp-fermented sago waste was compatible with substituting corn in feed without reducing ducks' productivity.

ACKNOWLEDGEMENT

The SMARTD unit of the Indonesian Agency for Agricultural Research and Development funded this work. I want to thank Prof (R) Dr. Gono Semiadi of LIPI and Dr. L. Hardi Prasetyo of the Indonesian Research Institute for Animal Production for mentoring this article.

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