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Research Article

The Impact of Dietary Fermented Seaweed (*Turbinaria murayana*) with Fruit Indigenous Micro Organism's (IMO's) as a Starter on Broiler Performance, Carcass Yield and Giblet Percentage

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Abstract | The research aimed to evaluate the impact of dietary fermentedseaweed (*Turbinaria murayana*) with Indigenous Micro-Organism (IMO's) from fruit waste as starter on performance, carcass yield and giblets percentage. A total of 100 one- d- old Arbor Acres CP 707 broilers was raised for 4 weeks of age. The birds were distributed into 5 treatments with 4 replicates in a completely randomized design. The fermented seaweed was supplemented at the level of 0, 5, 10, 15 and 20 % in the diets. The observed variables were live weight, body weight gain, feed intake, feed conversion ratio, percentage of carcass and giblets weight. The results showed that *Turbinaria murayana* fermented by IMO's fruit waste up to 20% on feed highly significant effect ($P \leq 0.01$) of body weight, feed conversion, carcass quality, and did not significant effect of nutrient consumption and physiology organ. In conclusion, utilization of fermented *Turbinaria murayana* by IMO's fruit wasted can be supplemented up to 15% in broiler diets to replace corn and rice bran.

Keywords | Broiler, Carcass, IMO's fruit waste, Physiology organ, *Turbinaria murayana*

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INTRODUCTION

Feed is the main factor in determining the successfulness of broiler poultry. One of the biggest problems farming faces is the high price and uncertain poultry feed composition due to human food competition like corn, soybean meal, and fish powder. Rusli et al. (2015) state that poultry feed took the highest portion of the rising production of animal costs. Around 60-70% has to be budgeted from the entire production cost (Kartasudjana and Suprijatna, 2010). Furthermore, most of the ingredients is still compete with human needs.

One of the solving proposals of broiler feed supply is utilizing alternative composition not used for human food, reachable prices, accusable, sustainable, and support broiler nutrition like *Turbinaria murayana. Turbinaria murayana* is a kind of brown seaweed living in the ocean without root, stem, and natural leaf (Reski et al., 2020). The brown seaweed is abundant on Nipah seashore, Pesisir Selatan District, West-Sumatera, Indonesia. *However, Turbinaria murayana* is living naturally and not utilized yet by society ranging from 5-10 tons/km^2 (Reski et al., 2021a).

Previous research revealed that to reduce the salt (NaCl) content on the *Turbinaria murayana* must be soaked in the flowing water. The treatment reduces 10% NaCl content on broiler feed nutrition. After washing for 3 hours on the flowing water, the *Turbinaria murayana* composition becomes 6.35% crude protein, 15.65% crude fiber, 0.97%

crude fiber, 0.26% Ca, 0.26% Ca, 0.42% P, 1599.14 Kcal/Kg ME, 13.51% Alginate, and 0.76% NaCl (Reski et al., 2020). In addition, the *Turbinaria Murayama* would be fermented through five types of IMO'S inoculum. Which are; IMO's fruit waste, IMO's a banana hump, IMO's rice, IMO's bamboo shoots, IMO's vegetable waste. The proportion of substrate and inoculum is 250/500 g/ml for seven day incubation time. Therefore, the best treatment comes for IMO's fruit waste creating the composition of 21.43% crude protein, 5.27% crude fiber, 2,01% Ca, 0.32% P, dan 1721.67 Kcal/Kg ME (Reski et al., 2021b). Adrizal et al. (2017) reported that using several Indigenous microorganisms (IMO's) such as IMO's rice, vegetables, fruit, bamboo shoots and banana hump to degrade pineapple waste can increase its nutrient content as poultry feed ingredients.The best-fermented *Turbinaria murayana* seaweed using IMO's fruit waste has never been tried in broiler rations, so it is necessary to research to see the effect of its use in broiler rations.

Therefore, this study aimed to evaluate the impact of dietary seaweed (*Turbinaria murayana*) fermented by Indigenous Micro-Organism (IMO's) from fruit waste as starter on performance, carcass yield and giblets percentage.

MATERIALS AND METHODS

Ethich statements

This experiment was conducted according to the Guideline for ethich study of experimental animal based on the law of Republic of Indonesia number 18 of 2019 about Animal Livestock and Animal Husbandry.

Fermentation process

To decrease crude fiber content, the research used fermenting *Turbinaria murayana* by IMO'sfruit waste, *Turbinaria murayana* seaweed was fermented using fruit waste inoculum IMO's with a substrate ratio of 250g/500ml MOL fruit inoculum for seven days of fermentation. Furthermore, the fermented seaweed was dried to a moisture content of 12% and then ground into flour. Fermented *Turbinaria murayana* was blended on feed composition based on treatment level and adjusted to iso protein and iso metabolisms energy. The research was conducted on the Educational Field of Animal Science Faculty, Universitas Andalas, continued to the Non-Ruminansia Nutrition laboratory.

Turbinaria murayana was taken from Sungai Nipah Beach, Pesisir Selatan District, West Sumatera. The *Turbinaria murayana* was soaked in the flowing water for three hours, then dry air for the next step was fermented through IMO's inoculum from fruit waste for seven days. Doses were 500ml/250g substrate. When the fermentation was completed, it was continued to dry under the sunlight up to the water content of 12% for the next step was to grind to become powder.

The trial cage and utensils on the research were cleaned then disinfected through chalk and Rhodalon® 5 cc/l water. The trial cage was numbered 1 to 20. Treatment was randomly treated by lottery system.10 DOC randomly taken, determined the weight to get average heaviness ass standard. Two levels of weightiness above and below were taken, then distributed on the cage number 1 to 20, and revers start from the lightest to the heaviest. The procedure was repeated to fulfill all of the cage 5 DOC each.

Animal and experimental design

A total of 100 one day old Arbor Acres CP 707 broilers with initial body weight between 45-50g/head was raised for 4 weeks of age. The birds were randomly distributed into 5 treatments with 4 replicates in a completely randomized design. The treatments were fermented *Turbinaria murayana* combined with corn, fish meal, rice bran, soybean meal, top mix, and coconut oil (Table 1 and Table 2). The diet was formulated isoprotein and isocaloric with 22% crude protein and 3000 kcal/kg metabolizable energy for 2 weeks of age and 20% crude protein and 3000 kcal/kg metabolizable energy for 3-4 weeks of age (Leeson and Summers, 2005) (Table 3 and Table 4). The treatment diets were: T1; Basal diet (without fermented seaweed), T2; Basal diet + 5% fermented seaweed, T3; Basal diet + fermented seaweed 10%, T4; Basal diet + fermented seaweed 15%, T5; Basal diet + fermented seaweed 20%.

Table 1: Nutrient composition (% dry base) and energy metabolized broiler feed for the first two weeks.

Nutrition composition	Protein (%)	Fat (%)	Crude fiber (%)	Ca (%)	P (%)	ME (%)
Corn[a]	8.50	3.80	2.50	0.01	0.13	3300.00
Fermented *Turbinaria murayana*[b]	20.39	2.29	5.01	1.91	0.30	2340.74
Soybean meal[c]	48.00	0.50	3.00	0.20	0.33	2550.00
Fish flour[c]	40.00	2.00	1.00	6.50	4.00	2750.00
Rice bran[c]	13.00	5.00	12.00	0.06	0.80	1900.00
Bone flour[c]	0.00	0.00	0.00	24.00	12.00	0.00
Coconut oil	0.00	100.00	0.00	0.00	0.00	8600.00

(a) NRC (1994); (b) Reski et al. (2021b); (c) Leesons and Summers (2005).

Table 2: Nutrient composition (% dry base) and energy metabolized broiler feed for the second 2 weeks.

Nutrition composition	Protein (%)	Lemak (%)	SK (%)	Ca (%)	P (%)	ME (%)
Corn[a]	8.50	3.80	2.50	0.01	0.13	3300.00
Fermented *Turbinaria murayana*[b]	20.39	2.29	5.01	1.91	0.30	2340.74
Soybean Meal[c]	48.00	0.50	3.00	0.20	0.33	2550.00
Fish Flour[c]	40.00	2.00	1.00	6.50	4.00	2750.00
Rice Bran[c]	13.00	5.00	12.00	0.06	0.80	1900.00
Bone Flour[c]	0.00	0.00	0.00	24.00	12.00	0.00
Coconut Oil	0.00	100.00	0.00	0.00	0.00	8600.00

(a) NRC (1994); (b) Reski et al. (2021b); (c) Leesons and Summers (2005).

Table 3: Nutrient formula and ingredient broiler feed for the first two weeks.

Nutrien formula	A	B	C	D	E
Corn	50.00	49.00	48.00	47.00	46.00
Fermented *Turbinaria murayana*	0.00	5.00	10.00	15.00	20.00
Soybean meal	19.00	19.00	19.00	19.00	18.00
Fish flour	18.50	17.50	16.50	15.50	14.00
rice bran	10.00	7.00	4.00	1.00	0.00
Bone flour (top mix)	0.50	0.50	0.50	0.50	0.00
Coconut oil	2.00	2.00	2.00	2.00	2.00
Total (%)	100.00	100.00	100.00	100.00	100.00
Protein	22.07	22.21	22.36	22.50	22.23
Fat	4.87	4.77	4.68	4.58	4.58
Crude fiber	3.21	3.06	2.92	2.77	2.83
Calsium	1.37	1.40	1.43	1.46	1.33
Phosphor	1.01	0.96	0.91	0.86	0.74
ME	3005.25	3004.79	3004.32	3003.86	3002.15

Table 4: nutrient formula and ingredient broiler feed for the second two weeks.

Nuttrient formula	A	B	C	D	E
Corn	54.00	53.00	52.00	51.00	50.00
Fermented *Turbinaria murayana*	0.00	5.00	10.00	15.00	20.00
Soybean meal	19.50	19.00	18.50	18.00	17.50
Fish flour	14.00	13.00	12.00	11.00	10.00
Rice bran	10.00	7.50	5.00	2.50	0.00
Bone flour (Top Mix)	0.50	0.50	0.50	0.50	0.50
Coconut oil	2.00	2.00	2.00	2.00	2.00
Total (%)	100.00	100.00	100.00	100.00	100.00
Protein	20.85	20.82	20.79	20.76	20.73
Fat	4.93	4.86	4.79	4.72	4.65
Crude fiber	3.28	3.18	3.08	2.98	2.88
Calsium	1.08	1.11	1.14	1.16	1.19
Phosphor	0.83	0.79	0.74	0.69	0.64
ME	3026.25	3022.54	3018.82	3015.11	3011.40

Data collection

Broiler performance

Feed intake (g/head/days) was determined every week by calculating the difference in feed supply, and the remaining feed was divided into seven to get each day's data. Body weight gain (g/head/days) was determined as the difference between two consecutive weighing every week and was divided by seven day. Feed conversion ratio was assessed by evaluating the proportion of feed intake and body weight gain.

Percentage of carcass and giblet weight

Live weight or final weight (g/head) were measured at the fourth weeks of age, chickens from each treatment group were weighed for their live weight. Percentage of the carcass was determined by calculating the proportion of carcass mass and body weight multiplied 100%. Percentage of the fat abdomen was observed by evaluating proportion between the fat stomach and bodyweight multiplied 100%.

Giblet weight percentage

Giblet weight percentage was observed by exploring the percentage of the liver, pancreases, and gizzard weight to body weight. Sampling procedure by taking one chicken from each treatment at the age of 4 weeks, then weighing the body weight before being cut to take the liver, pancreas and gizzard. Then each organ is weighed, and the weight of each organ is divided by live weight to get the percentage of its weight.

Statistical analysis

Data were analyzed using SPSS version 25 and Duncan's multiple range test comparison was applied to compare treatment means. Significance was declared at $p < 0.05$ to differentiate between treatments.

RESULTS AND DISCUSSION

Table 5 shows that the dietary fermented *Turbinaria* *murayana* at different levels, giving highly significant (P≤0.01) to escalate body weight and feed conversion of broiler nutrition, even though insignificant (P≥0.05) to ration consumption. Furthermore, fermented *Turbinaria murayana* success accelerates the broiler carcass quality through life weight, carcass percentage, and fat abdomen percentage highly significant (P≤0.01) (Table 6). In addition, beyond the effective utilization of *Turbinaria murayana* on broiler performance and carcass quality, the supplement insignificantly (P≥0.05) increased the weight of broiler liver, pancreases, and gizzard like reveal on (Table 7).

Broiler performance

Bodyweight

The use of Turbinaria murayana seaweed as a fermented product of IMO's fruit waste up to a level of 15% in the ration could match the live weight of the treatment without the use of seaweed (control), but use at the level of 20% in the ration caused a decrease in live weight compared to the control treatment. Utilizing fermented *Turbinaria murayana* for 15% succeeded in replacing rice bran and some corn on broiler feed formula. Reski et al. (2021b) reported fermented *Turbinaria murayana* to have a typically similar composition to rice bran and corn. However, consuming fermented *Turbinaria murayana* up to 20% increasing component alginate on feed led to a drop-down in the bodyweight of broiler. Turbinaria murayana seaweed contains alginate of 13.51%, so there is 2.7% in the ration using seaweed at the 20% level. Alginate is a fiber compound that cannot be digested in the body of broilers, thus causing the growth of broilers that consume rations containing higher alginate lower than control rations. Dewi et al. (2018) reported decreasing the body weight of poultry that feed with indigestible alginate. Furthermore, Dewi et al. (2019) revealed that alginate content on seaweed Sargassum binderi decreases the alginate content by fermenting *Bacillus megentarium* S245.

Table 5: Average performance (ration consumption, body weight gain, and feed conversion) of broilers during the four weeks of the study.

Treatment	Ration consumtion (g/head/day)	Weight gain (g/head/day)	Feed conversion
A (0% Fermentation Products)	71.18	42.57[a]	1.70[b]
B (5% Fermentation Products)	71.93	42.03[a]	1.71[b]
C (10% Fermentation Products)	72.04	42.13[a]	1.73[b]
D (15% Fermentation Products)	72.17	41.18[a]	1.75[b]
E (20% Fermentation Products)	72.21	37.59[b]	1.95[a]
SE	0.29	0.57	0.02

SE: Standar Error; The different superscripts in the same column indicate differences at (P>0.05).

Table 6: Average carcass quality (live weight, percentage of carcass, and percentage of abdominal fat) of broilers during the four weeks of the study

Treatment	Live weight (g/head)	Percentage of carcass (%)	Prcentage of abdominal fat (%)
A (0% Fermentation products)	1359.50[a]	71.57[a]	0.81[a]
B (5% Fermentation products)	1374.50[a]	70.51[a]	0.85[a]
C (10% Fermentation products)	1387.50[a]	70.67[a]	0.52[b]
D (15% Fermentation products)	1364.25[a]	70.30[a]	0.54[b]
E (20% Fermentation products)	1214.25[b]	68.36[b]	0.41[c]
SE	11.61	0.40	0.03

SE: Standar Error; The different superscripts in the same column indicate differences at (P>0.05).

Table 7: The average percentage of physiological organs (percentage of liver, percentage of pancreas, and percentage of ventriculus) of broilers during the four weeks of the study.

Treatment	Percentage of liver (%)	Percentage of pancreas (%)	Percentage of ventriculus (%)
A (0% Fermentation products)	2.33	0.28	2.18
B (5% Fermentation products)	2.52	0.26	2.14
C (10% Fermentation products)	2.58	0.28	2.27
D (15% Fermentation products)	2.60	0.30	2.36
E (20% Fermentation products)	2.55	0.29	2.30
SE	0.14	0.02	0.07

SE: Standar Error

Feed intake

Turbinaria murayana seaweed fermented products up to a level of 20% in the ration can match the consumption of rations in the control treatment (0% seaweed). This was because the shape, aroma and colour of the feed were not so different so that the palatability of the ration for each treatment was not different. The palatability of the ration is determined by the taste, smell and colour that can cause appetite in livestock (Reski et al., 2021a). Furthermore, Reski et al. (2021b) reported applying 3 hours length soaked *Turbinaria murayana* up to 10% as broiler supplemented, maintaining palatability. Application fermented *Turbinaria murayana* implicate substituting rice bran and some part of corn as an energy source without changing the tastiness. Therefore, feed consumption affects poultry's physical form and nutrient balance (Kartasudjana and Suprijatna, 2010). Thirumalaisamy et al. (2016) also stated the same idea, who verify feed consumption affected by nutrition component, protein balancing, and energy.

Body weight gain

Application of fermented *Turbinaria murayana* to 15% maintain body weight of broiler. However, increasing the application to 20% led to reducing the broiler's body weight. The reduction happened because 20% of applications contain higher alginate. *Turbinaria murayana* seaweed contains 13.51% alginate, so there is about 2.7% in the ratio at 20% usage level. Alginate in the body acts as a binder for bile salts in the liver, while bile salts are the essential ingredients for forming fat and cholesterol; thus, the higher levels of alginate in the ration will reduce the fat in broiler meat, so that weight gain decreases. Dewi et al. (2019) reported that high alginate content in Sargassum binderi seaweed could reduce weight gain in poultry because alginate is a fiber compound that cannot be digested in the poultry body, so processing of alginate reduction using fermentation technology using Bacillus megatherium was carried out. S245. Horhoruw et al. (2009) reported a similar phenomenon, which informed a decrease of broiler body mass and increasing seaweed supplements on feed. Therefore, utilization of seaweed itself is only recommended on level 15%.

Feed conversion ratio

Conversion of treatment rations using Turbinaria murayana seaweed fermented product MOL fruit waste to a level of 15% in rations can match the conversion of treatment rations without using fermented seaweed products (control rations). This is because consumption and weight gain of the treatment up to 15% in the ration are also not different. Rizal et al. (2010) explained that feed conversion is the value of comparing feed intake and gaining weight. Utilization of fermented *Turbinaria murayana* up to 20% is not efficient as feed conversion. This is consistent with the weight gain in the treatment using Turbinaria murayana seaweed fermented products at the 20% level, which is also lower than the treatment using fermented seaweed products at the 15% level, causing the conversion to be poor and inefficient. Zainuddin et al. (2020) argue feed conversion is affected by feed consumption and body weight, which figure feed needs to supply to be converted into meat.

Percentage of carcass

Feed supplemented by fermented *Turbinaria murayana* to 15% giving similar effect with the control. Nevertheless, a 20% feed increase has drawbacks to the percentage of the carcass. Murtidjo (2003) states that the rate of the carcass is one factor in determining meat purpose animal cause related with body weight, which supports carcass production. Reski et al. (2021a) reported utilizing unfermented *Turbinaria murayana* up to 10% supplemented on broiler feed similarly to commercial feed. Furthermore, Dewi et al. (2018) argue alginate content on seaweed reduces carcass quality.

Percentage of abdomen fat

The percentage of abdominal fat in the treatment of *Turbinaria murayana* seaweed rations fermented products to a level of 20% lower than the control treatment (0% seaweed). The higher the use of seaweed in the ration, the lower the abdominal fat percentage in broilers consuming the treatment ration. This is due to rations containing *Turbinaria murayana* seaweed fermented product MOL fruit waste containing alginate, which can reduce fat and cholesterol levels in the broiler body. Reski et al. (2021a) explained that feed supplement by non-fermented *Turbinaria murayana* to 10% can decrease the percentage of the fat abdomen to alginate content by binding bile salt on digest track, decreasing broiler percentage fat abdomen. The same opinion is also restated by Panjawidjaja (2008), who declare seaweed *Gracilaria verrucosa* and *Euchemia cottoni* supplemented up to 4.5% to broiler reduce fat abdomen.

Percentage of liver weight

The research figuring broiler supplemented by fermented *Turbinaria murayana* up to 20% showed insignificantly changing liver weight to the control. In other words, fermented *Turbinaria murayana* does not have side effects on the digestive system. Additionally, liver weight is affected by several factors like animal type, body size, genetic, and nutrient consumption (El-deek and Brika, 2009). Furthermore, Abbas et al. (2020) state that the size of the liver depends on the shape of feed and the nutrition component of consumption.

Percentage of pancreases weight

The research revealed that fermented *Turbinaria murayana* supplements on broiler feed insignificantly affect the pancreas' weight. Consequently, fermented *Turbinaria murayana* supplements do not disturb the function of the pancreas to produce digestive enzymes. Mahata et al. (2008) reported pancreases working to support the digestive system to absorb fat and protein. Applying non-fermented *Turbinaria murayana* to 10% still does not affect pancreatic function (Reski et al., 2021a). Additionally, Hendro (2015) reported that three types of seaweed supplements for 10% do not affect pancreases weight.

Percentage of gizzard weight

Like liver and pancreases, supplement fermented *Turbinaria murayana* to broiler feed up to 20% insignificantly changing ventricular. The insignificantly happened because the shape of broiler feed is homogenously led to gizzard work softly into grinding intake food. Simanjuntak and Patabo (2016) state the ventricular size based on body size, type, and volume of feed consumption. Moreover, Mutia et al. (2017) gizzard size is affected by fiber content on feed because gizzard works mechanically. Non-fermented *Turbinaria murayana* to 10% feed application on broiler also do not affect broiler ventricular.

CONCLUSIONS AND RECOMMENDATIONS

To sum up, 15% is the maximum fermented *Turbinaria murayana* application on broiler feed that does not disturb the physiological organ of the broiler. In addition, to the 15% application, fermented *Turbinaria murayana* succeeded in substituting rice bran and some corn on poultry feed.

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NOVELTY STATEMENT

This study used *Turbinaria murayana* seaweed fermented using MOL fruit waste as a substitute for bran and corn, which previous researchers had not studied. The use of this material in broiler rations can improve the performance and quality of broiler carcasses

AUTHOR'S CONTRIBUTION

The author at this moment declares that this work was carried out by all those mentioned in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by them. Sepri Reski, Maria Endo Mahata, and Ridho Kurniawan Rusli conceived the idea, participates in data collection and run the test. All authors participated in conceptualizationof the idea, study design, review, and editing of paper. All authors have read and agreed with submission of final paper to the journal.

Conflict of interest

The authors have declared no conflict of interest.

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