



Padina australis with Reduced Salt and Crude Fiber Content: Evaluation of Growth Performance and Physiological Organs of Broiler Chickens

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Abstract | *Padina australis* was a brown seaweed that had potential as a poultry feed ingredient. The high salt and crude fiber content of the brown seaweed *Padina australis* is a limiting factor for its use in broiler chicken diets. In this study, immersing in water flow reduced the salt content of the brown seaweed *Padina australis*. Crude fiber was reduced by fermentation using local microorganisms as inoculum. This study aimed to determine the effect of brown seaweed *Padina australis*, with reduced salt and crude fiber content, on the growth performance and physiological organs of broiler chickens. This study used a Completely Randomized Design (CRD) with brown seaweed *Padina australis* levels of 0, 5, 10, and 15% in broiler chicken diets, with each treatment repeated five times. The parameters measured were daily feed intake, daily body weight gain, feed conversion, final body weight, carcass percentage, abdominal fat pad percentage, and physiological organs of broiler chickens. The results showed that the use of *Padina australis* had no significant effect ($p > 0.05$) on growth performance and significantly reduced the abdominal fat pad percentage of broiler chickens ($p < 0.05$). Furthermore, in this study, *Padina australis* generally did not affect ($p > 0.05$) the physiological organs, but it significantly affected ($p < 0.05$) the gizzard weight percentage and gallbladder weight percentage of broiler chickens. In conclusion, *Padina australis* in broiler chicken diets could be used up to 15% without disrupting growth performance while reducing the abdominal fat pad percentage and not affecting the physiological organs of broiler chickens in general.

Keywords | Broiler, Fermentation, Immersion, Local microorganisms, *Padina australis*, Salt and crude fibre content

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INTRODUCTION

The growth of the broiler chicken industry in Indonesia is driven by increasing domestic demand but is still constrained by dependence on imported feed that is vulnerable to price fluctuations. Utilizing local feed ingredi-

ents is a strategic step to reduce dependence on imported ingredients. Several researchers have enriched the scientific literature on brown seaweed as a poultry feed ingredient (Mohammadigheisar *et al.*, 2020; Reski *et al.*, 2021; Akinyemi and Adewole, 2022; Mahata *et al.*, 2023a). Although previous researchers have reported the benefits of

brown seaweed in general. However, there has been no specific study on the effectiveness of *Padina australis*, which has had its salt and crude fiber content reduced in broiler diets. This indicates an opportunity for further research to overcome dependence on imported feed ingredients.

Padina australis contains crude fiber 10.79%, crude fat 0.92%, crude protein 8.61%, phosphorus 1.43%, calcium 5.12%, NaCl 10.07%, gross energy 1643.69 kcal/kg, alginate 8.65%, fucoidan 0.87%, and fucoxanthin 0.75 mg/g (Flora et al., 2023; Mahata et al., 2015; Saloso et al., 2020). Various contain active compounds in *Padina australis*, such as saponins, flavonoids, alkaloids, tannins, terpenoids, and steroids (Saloso et al., 2020). Furthermore, *Padina australis* contains phenolic compounds and their derivatives (flavonoids), B-carotene, fucoxanthin, diadinoxanthin, algininate, diatoxanthin, and chlorophyll (Setha et al., 2013; Hasanela and Souhoka, 2022). Flavonoid compounds contribute to antioxidant activity, which can enhance the immune response in poultry (Sari et al., 2021). Akbari et al. (2021), Stated that extracts from *Padina australis* showed antimicrobial properties against pathogenic bacteria such as *Staphylococcus aureus* and *Escherichia coli* which can reduce disease in broiler chickens. Furthermore, Hakim and Patel, (2022), stated that *Padina* contains various bioactive compounds, including antioxidants and essential oils, which can reduce stress and improve poultry health and performance.

Padina australis can be used as a functional feed ingredient for poultry because, in addition to contributing to meeting nutritional needs, its bioactive substances can improve poultry health and performance. However, brown seaweed *Padina australis* contains high salt and crude fiber, so its use in poultry diets remains limited. The salt content in seaweed can be reduced by immersing it in running water, immersing brown seaweed *Padina australis* in water flow for 4 hours can reduce the salt content from 10.70% to 0.27% (Mahata et al., 2023b). Furthermore, the crude fibre content can be reduced through fermentation with local microorganisms from rice. The fermentation reduces crude fiber from 10.79% to 2.20%, then the fermented product of *Padina australis* contains water content of 7.21%, dry matter of 92.79%, organic matter of 76.16%, crude fat of 4.40%, crude protein of 17.12%, calcium 6.49%, phosphorus 0.54%, alginate 39.88%, fucoidan 0.33%, and metabolic energy 1374 Kcal/kg (Mahata et al., 2023c).

The high salt and crude fiber content of the brown seaweed *Padina australis* is a limiting factor for its use in broiler chicken diets. In this study, immersing in water flow reduced the salt content of the brown seaweed *Padina australis*. Crude fiber was reduced by fermentation using local microorganisms as inoculum. This approach addresses the gap in the current literature regarding the use of *Padina australis* as a feed ingredient for broiler chickens. This is

due to the limited research that has effectively reduced salt and crude fiber levels to make it more beneficial as poultry feed. The method used can increase the nutritional content of brown seaweed *Padina australis* and make it a better alternative feed ingredient for broiler chickens. Thus, this study contributes to the scientific literature and supports the poultry feed industry by providing a more affordable alternative feed ingredient and reducing dependence on conventional feed ingredients that may be more expensive. Based on the description above, an evaluation study has been conducted using brown seaweed *Padina australis*, which has had its salt and crude fiber content reduced in broiler chickens' growth performance and physiological organs.

MATERIALS AND METHODS

ETHICAL APPROVAL

The Research Ethics Committee of Universitas Andalas, Padang, Indonesia, approved the study in compliance with ethical standards for animal research, under registration no. 517/UN.16.2/KEP-FK/2024.

BIRD

This study used a one hundred Day Old Chick (DOD) broiler of CP 707 strain with an average weight of 45.91 g. The experimental broilers were placed in 20 cages measuring 60x50x50 cm, each containing five chicks.

PREPARATION PROCEDURE OF BROWN SEAWEED *PADINA AUSTRALIS*

Padina australis seaweed was collected from Sungai Nipah Beach, Pesisir Selatan Regency, West Sumatra Province, Indonesia. The seaweed was rinsed to remove any residual sea sand and small corals and then immersion in water flow for 4 hours. Furthermore, the brown seaweed *Padina australis* was randomly chopped so that it was smaller in size to expand the surface of the seaweed and facilitate the penetration of enzymes produced by microbes. Furthermore, it was fermented using local microorganisms from rice, with a ratio of 1:2 (seaweed: local microorganisms), then incubated for 14 days. The fermentation product was dried, ground, and prepared as a feed ingredient for broiler diets.

EXPERIMENTAL DESIGN

The research employed a Completely Randomized Design (CRD) featuring four different levels of *Padina australis* seaweed (0, 5, 10, and 15%) in broiler diets, with each level tested across five replications.

DIETARY TREATMENT

The diets used in this study were formulated according to the needs of broiler chickens. The feed ingredients that make up the treatment diets include brown seaweed *Padina*

Table 1: Composition of experimental diets, content of nutrients substances, and energy metabolism.

Feed Composition (%)	Treatment diets (%)							
	Starter phase (1-2 Weeks)				Grower phase(3-5 Weeks)			
	A	B	C	D	A	B	C	D
Ground maize	47.91	47.08	46.25	45.42	57.00	55.00	53.00	51.00
Rice bran	11.40	7.60	3.80	0.00	12.44	9.31	6.18	3.05
Soybean meal	27.62	26.08	24.54	23.00	15.60	14.70	13.80	12.90
MBM	7.00	7.00	7.00	7.00	7.30	7.30	7.30	7.30
CGM	5.30	6.00	6.70	7.40	7.10	7.35	7.60	7.85
Lysine	0.13	0.19	0.25	0.31	0.22	0.28	0.34	0.40
Methionine	0.09	0.10	0.11	0.12	0.05	0.05	0.05	0.05
Palm oil	0.55	0.95	1.35	1.75	0.29	1.01	1.73	2.45
Padina australis	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
Total	100	100	100	100	100	100	100	100
Content of nutrients substances (%), and energy metabolism (kcal/kg)	Starter phase (1-2 Weeks)				Grower phase (3-5 Week)			
	A	B	C	D	A	B	C	D
	A B C D				A B C D			
Crude protein	23.29	23.28	23.26	23.24	20.00	20.00	20.00	20.00
Crude fat	3.60	3.88	4.15	4.42	3.42	4.04	4.65	5.27
Crude fiber	3.36	3.06	2.75	2.44	3.34	3.08	2.83	2.57
Calcium	0.97	1.28	1.59	1.91	0.96	1.27	1.58	1.89
Phosphorus Available	0.64	0.58	0.53	0.47	0.65	0.61	0.56	0.51
Lysine	1.34	1.33	1.32	1.32	1.14	1.14	1.15	1.16
Methionine	0.54	0.54	0.53	0.53	0.47	0.45	0.44	0.43
Alginate	0.00	1.99	3.99	5.98	0.00	1.99	3.99	5.98
Fucoidan	0.00	0.02	0.03	0.05	0.00	0.02	0.03	0.05
NaCl	0.00	0.01	0.03	0.04	0.00	0.01	0.03	0.04
Energy metabolism	2804	2804	2804	2804	2905	2904	2902	2900

A: Diet contains 0% of *Padina australis*; **B:** Diet contains 5% of *Padina australis*; **C:** Diet contains 10% of *Padina australis*; **D:** Diet contains 15% of *Padina australis*.

australis, ground maize, rice bran, palm oil, soybean meal, lysine, methionine, corn gluten meal (CGM), and meat bone meal (MBM). The four treatment diets used in the study contained 23.20% protein with an energy metabolism of 2800 kcal/kg for starter-period broiler chickens (1-2 weeks) (Table 1). Furthermore, the treatment diet was 20% for the grower period, with an energy metabolism of 2900 kcal/kg (Table 1).

PARAMETERS MEASURED

Daily feed intake: The total amount of feed intake provided (g) to the broiler chickens minus the total amount of left-over feed (g) by broiler and divided 35 days (experiment period) (Ojediran *et al.*, 2017). **Daily weight gain:** Broiler chicken's body weight (g) at the end of the experiment period minus initial broiler body weight (g) and was divided by 35 days (experiment period) (Ojediran *et al.*, 2017). **Feed conversion:** feed conversion (g/bird/day) divided by body weight gain (g/bird/day) (Ojediran *et al.*, 2017). **Final body weight:** The final body weight of the broiler chick-

ens was obtained by weighing the live weight before being slaughtered (g) at the end of the experiment, which was previously fasted for 10 hours (Ralahalu *et al.*, 2020). **Carcass percentage:** Carcas of broiler chickens were weighted (g), divided by the final body weight of broiler chickens (g), and multiplied by 100% (Gopinger *et al.*, 2014). **Abdominal fat pad percentage:** The abdominal fat pad was weighed (g), and divided with weight (g), and then multiplied by 100% (Jimenez-Moya *et al.*, 2021).

Sampling and measurement of the physiological organs of broiler chickens were carried out at the age of 35 days. The physiological organs of broiler chickens were sampled on one chicken for each treatment. This experiment consisted of 5 treatments, each repeated four times so that the total sample for physiological organ analysis was 20. Samples were randomly selected from 100 chickens weighed and slaughtered according to animal welfare provisions. Before being slaughtered, the chickens were fasted for 8 hours. After being slaughtered, physiological organs such as the

gizzard, pancreas, liver, heart, spleen, gallbladder, and small intestine (duodenum, jejunum, and ileum) were separated and weighed with a 0.001 g digital scale. The percentage weight of each physiological organ was calculated using the formula: Relative weight = (organ weight/live weight) × 100% (Nastain *et al.*, 2021). Furthermore, the length of the duodenum, jejunum, and ileum was measured (cm).

STATISTICAL ANALYSIS

All data were analyzed using Analysis of Variance (ANOVA), and Duncan's Multiple Range Tests (Steel and Torrie, 1995) were employed to determine the differences between the treatments.

RESULTS AND DISCUSSION

The results of statistical analysis showed that the use of brown seaweed *Padina australis* had no significant effect ($p>0.05$) on the daily feed intake of the broiler (Table 2). The processed brown seaweed *Padina australis* had the same palatability as conventional feed ingredients, so its use of up to 15% did not interfere with the daily feed intake of the broiler. The palatability of the diet was determined by the taste, smell, and color, which contributed to the live-stock's appetite (Alnasrawi, 2016). The use of brown seaweed *Padina australis* does not interfere with the daily feed intake of broilers because the nutritional content required by broilers in each treatment diet has been met. The use of *Padina australis* at each level does not change the nutritional content of each treatment diet, so the consumption level remains the same. The balance of nutrients influences feed consumption in poultry, the ratio of energy and protein in the ration, the form of feed, and age (Liu *et al.*, 2017; Nuraini *et al.*, 2022; Sung and Adeola, 2022). The use of *Padina australis*, reduced in salt and crude fiber content by up to 15%, did not interfere with broiler daily feed intake of broilers. The level of brown seaweed use in this study was the same as that reported by Reski *et al.* (2022), brown seaweed *Turbinaria murayana*, which has had its salt and crude fiber content reduced, can be used as much as 15% in broiler diets.

Table 2: Average daily feed intake, daily body weight gain, and feed conversion of broiler chickens treated with *Padina australis*.

Level of <i>Padina australis</i> (%)	Daily feed intake (g/bird/d)	Daily weight gain (g/bird/d)	Feed conversion
0	66.81	39.69	1.70
5	70.69	44.95	1.60
10	67.93	39.63	1.72
15	66.34	38.12	1.74
SE	1.42	1.67	0.80

Note: Parameter values in the same column showed no significant differences ($p>0.05$); SE: Standard error.

The results of statistical analysis showed that the use of brown seaweed *Padina australis* had no significant effect ($p>0.05$) on the daily weight gain of broiler chickens (Table 2). The processed brown seaweed *Padina australis* maintained the broiler's daily feed intake so that daily weight gain was not disturbed. Feed intake that could be maintained by using *Padina australis* in the diet caused the nutrients and energy consumed in each treatment to be the same so that the nutritional needs of broiler chickens for all treatments were met. The amount of feed intake can determine the amount of weight gain (Rizal *et al.*, 2010). Previous researchers reported that supplementing brown seaweed in diets can increase weight gain in broiler chickens (Chavan *et al.*, 2022; Andri *et al.*, 2020).

The results of statistical analysis showed that the use of brown seaweed *Padina australis*, which had been reduced in salt and crude fiber content, had no significant effect ($p>0.05$) on feed conversion of broiler (Table 2). The processed brown seaweed *Padina australis* maintained feed intake, followed by stable body weight gain, so feed conversion was not disturbed. The feed conversion value was closely related to feed intake and body weight gain. Rizal *et al.* (2010), states that feed conversion is a comparative value between feed intake and weight gain. Furthermore, Metzler-Zebeli *et al.* (2016), states the feed conversion value is influenced by broiler chickens' feed intake and body weight gain.

The results of statistical analysis showed that the use of brown seaweed *Padina australis*, which had been reduced in salt and crude fiber content, had no significant effect ($p>0.05$) on the final body weight of broiler chickens (Table 3). In this study, daily feed intake and daily weight gain of broiler chickens were the same for each treatment, so the live weight of broiler chickens was also the same. The live weight of broiler chickens was influenced by the amount of feed intake and daily weight gain (Manullang *et al.*, 2016). The same thing was also reported by Murtidjo (2003): live weight is very closely related to feed intake; the higher the feed intake, the higher the live weight, and vice versa.

Table 3: Average final body weight, carcass percentage, and abdominal fat pad percentage of broiler chickens treated with *Padina australis*.

Level of <i>Padina australis</i> (%)	Final body weight (g/bird)	Carcass percentage	Abdominal fat pad percentage
0	1359.20	71.66	2.29 ^a
5	1432.20	72.05	1.54 ^b
10	1289.20	71.52	1.45 ^b
15	1238.80	71.50	1.49 ^b
SE	48.84	0.40	0.40

Note: Different superscripts in the same column indicate statistically significant effects ($P<0.05$) among treatments; SE: Standard error.

The results of statistical analysis showed that the use of brown seaweed *Padina australis*, which had been reduced in salt and crude fiber content, did not have a significant effect ($p>0.05$) on the carcasses percentage of broiler chickens (Table 3). The carcass percentage of the broiler was influenced by live weight. In this study, the live weight of broiler chickens was not influenced by the use of brown seaweed *Padina australis* in broiler chicken diets. One factor influencing the percentage of broiler carcasses is live weight because carcasses are obtained from the comparison between carcass weight and live weight (Iwuji *et al.*, 2022). The energy level in the diets, strain type, and gender affect broiler chickens' carcass weight (Ikusika *et al.*, 2020; Munoz *et al.*, 2018).

The results of statistical analysis showed that the use of brown seaweed *Padina australis* has a significant effect ($p<0.05$) on the abdominal fat pad percentage of the broiler chickens (Table 3). This is due to the alginate content of brown seaweed in *Padina australis*. Increasing the level of use of brown seaweed *Padina australis* in broiler diets will increase the alginate content in the diet. Alginate cannot be digested by poultry because there is no alginate lyase enzyme in the poultry digestive tract to hydrolyze alginate (Surbayono, 2016). Alginate can reduce the abdominal fat content of broiler chickens by binding bile salts which function to dissolve fat and cholesterol in the digestive tract of broiler chickens, so that fat and cholesterol absorption is lower. Wikanta *et al.* (2003), reported that alginate cannot be digested in the body, and the body will actively reproduce bile salts, the main ingredient of which is fat, to reduce fat levels. La *et al.* (2023) reported that alginate supplementation in broiler chicken rations can reduce fat accumulation. Furthermore, Mahata *et al.* (2023b), reported the use of brown seaweed *Sargassum crassifolium* can reduce the percentage of abdominal fat in broiler chickens. The use of brown seaweed *Padina australis* can be used as an alternative feed ingredient and can also reduce the percentage of abdominal fat in broiler chickens. This finding has the potential to support the poultry feed industry by providing more affordable alternative feed ingredients.

The results of statistical analysis showed that the use of brown seaweed *Padina australis* did not have a significant effect ($p>0.05$) on the physiological organs of broiler chickens (pancreas weight percentage, liver weight percentage, heart weight percentage, spleen weight percentage, duodenum length, jejunum length, and ileum length). However, it was significantly different ($p<0.05$) in the gizzard weight percentage and the gallbladder weight percentage of the broiler (Table 4).

The use of brown seaweed *Padina australis* in broiler chicken diets up to 15% did not affect ($p>0.05$) the pancreas weight percentage of the broiler chicken (Table 4). This

is due to the brown seaweed *Padina australis* being processed before being used as a feed ingredient in broiler chicken diets. The results of this study differ from those reported by Reski *et al.* (2022), the use of brown seaweed *Turbinaria murayana* in broiler diets affects the pancreas weight percentage of broiler, which is caused by the alginate content in *Turbinaria murayana*. The composition of alginate, especially the ratio of its monomeric units such as mannuronate and guluronate, varies significantly between different seaweed species. This variation affects the physicochemical properties and potential applications of alginate. Rhein-Knudsen *et al.* (2017), stated that alginate from *Sargassum* spp showed a mannuronate and guluronate ratio of 0.47 and 0.70, while *Padina* spp had a higher mannuronate and guluronate ratio of 1.75 and 1.85, indicating significant differences in structural characteristics and gel strength. Furthermore, Niemi *et al.* (2024), stated that mannuronate and guluronate are essential for determining the properties of alginate. There was no increase in the pancreas weight percentage of the broiler, indicating that brown seaweed *Padina australis* is safe to use as a feed ingredient in broiler diets. The undisturbed pancreas weight percentage of the broiler is expected to allow the digestive enzymes produced by the pancreas to work optimally.

Table 4: Average physiological organs of broiler chickens treated with *Padina australis*.

Physiological organs (Variables)	Level of <i>Padina australis</i>				SE
	0	5	10	15	
Gizzard weight percentage	1.56 ^b	1.61 ^b	1.86 ^{ab}	1.94 ^a	0.09
Pancreas weight percentage	0.27	0.29	0.27	0.33	0.02
Liver weight percentage (%)	1.73 ^a	1.82 ^{ab}	1.94 ^b	1.98 ^b	0.06
Heart weight percentage (%)	0.55	0.52	0.60	0.58	0.02
Spleen weight percentage (%)	0.12	0.13	0.15	0.16	0.01
Gallbladder weight percentage	0.09 ^{bc}	0.08 ^c	0.11 ^b	0.13 ^a	0.005
Duodenum length (cm)	26.2	27.4	26.60	24.40	1.55
Jejunum length (cm)	64.2	60.6	62.60	59.00	3.38
Ileum length (cm)	47.4	52.6	56.40	58.80	2.94

Note: Different superscripts in the same row indicate statistically significant effects ($P<0.05$) among treatments; **SE:** Standard error.

The use of brown seaweed *Padina australis* in the broiler chicken diets did not affect ($p>0.05$) the liver weight percentage, heart weight percentage, and spleen weight percentage of broiler chickens (Table 4). This shows that the diet containing *Padina australis* does not contain dangerous toxic compounds and is still acceptable to the body of broiler chickens so that liver performance is not disturbed. In addition, the use of *Padina australis* can also maintain the color of broiler livers, which is reddish brown. Significant liver damage, characterized by a yellowish color and hard consistency, indicates toxicity (Biffi *et al.*, 2018). Further-

more, in this study, the NaCl content in the treatment diet ranged from 0.01 to 0.04%, and the salt content in each treatment diet was still below the tolerance limit of broiler chickens. Zhang *et al.* (2022), stated that the ideal NaCl content in broiler diets is no more than 0.24%. The absence of health problems in the liver of broilers consuming diets containing *Padina australis* is also caused by the content of flavonoid compounds, fucoidan, and other bioactive compounds. Flavonoid compounds contribute to antioxidant activity, which can increase the immune response in poultry (Sari *et al.*, 2021). Furthermore, Hakim and Patel (2022), stated that *Padina* contains various bioactive compounds including antioxidants and essential oils, which can reduce stress, improve poultry health and performance. Thus, the content of bioactive compounds in brown seaweed *Padina australis* can protect the liver of broiler chickens from the effects of other active substances, which can cause disorders in the liver of broilers. In addition, the use of brown seaweed *Padina australis* up to 15% in the diet also does not interfere with the heart weight percentage and the spleen weight percentage of broilers. This indicates that the use of brown seaweed *Padina australis* in the diet is not toxic, which can interfere with the liver, heart, and spleen in broilers.

The results of statistical analysis showed that the use of brown seaweed *Padina australis* has a significant effect ($p < 0.05$) on the gizzard weight percentage of the broiler chicken (Table 4). An increase in the gizzard weight percentage of in broilers consuming diets containing brown seaweed *Padina australis* indicates a disturbance in the mechanical digestion process of feed. *Padina australis* has a rougher texture than other feed ingredients, such as rice bran, MBM, and CGM used as feed ingredients in the treatment diet. Adding *Padina australis* levels in broiler diets causes the texture of the diet to become rougher. The rough texture of the feed causes the gizzard to work harder to break down the feed, thus affecting its weight. Svihus *et al.* (2024), stated that larger feed particles can improve optimal digestive function, further supporting broiler chicken gizzards' weight.

The results of statistical analysis showed that the use of brown seaweed *Padina australis* has a significant effect ($p < 0.05$) on the gallbladder weight percentage of broiler chickens (Table 4). The alginate and fucoidan content in *Padina australis* can affect the formation of bile acids which impact the broiler's gallbladder weight. This is similar to that reported by Yang *et al.* (2022), fucoidan and alginate from seaweed can increase intestinal microbiota and bile acid formation, which can indirectly affect the weight of the gallbladder.

The use of brown seaweed *Padina australis* in the diet did not significantly affect ($p > 0.05$) on the duodenum length,

jejunum length, and ileum length (Table 4). The results of this study are almost the same as those reported by El-Naga and Megahed (2018), brown seaweed supplementation improves intestinal health, but it does not significantly impact the broiler's relative weight in the intestine. Furthermore, Oretomiloye and Adewole (2024), reported that although brown seaweed increased the height of the jejunum villi, brown seaweed did not significantly change the overall length of the small intestine in broiler chickens. The seaweed based on the plant which is compounds include phenolic compounds, carotenoids, phytosterols, glucosinolates, minerals, vitamins, enzymes, bacteriocins, and unsaturated fatty acids (Siddiqui *et al.*, 2023). Over 5000 phytochemicals have been discovered in plant-based foods, differing in structure and composition (Siddiqui *et al.*, 2023). The use of brown seaweed *Padina australis* can reduce the abdominal fat pad percentage, does not interfere with growth performance, and does not generally interfere with broiler chickens' physiological organs. However, this study still has limitations because it was only conducted on broiler chickens. Its effects on laying hens are unknown, nor how it affects the quality of laying hen eggs.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the use of *Padina australis* in broiler diets can be used up to 15% without disrupting production performance, reducing the abdominal fat pad percentage, and not disrupting the physiological organs of broiler chickens in general. The use of *Padina australis* in broiler chicken diets can reduce conventional feed ingredients, such as 5.20% ground maize, 100% rice bran, and 16.73% soybean meal (starter phase). Furthermore, it reduces 10.53% ground maize, 75.48% rice bran, and 17.31% soybean meal (grower phase). Thus, farmers have alternative feed ingredients for broiler chickens like brown seaweed *Padina australis*.

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NOVELTY STATEMENT

Although the potential of brown seaweed as a feed ingredient has been widely studied, no study has specifically evaluated the effectiveness of *Padina australis*, which has been

modified by reducing salt and crude fiber levels in broiler diets. This study fills this gap in knowledge by evaluating the potential of processed *Padina australis* as an alternative local feed ingredient to reduce dependence on imports.

AUTHOR'S CONTRIBUTIONS

Maria Endo Mahata served in the conceptualization, investigation, methodology, and writing of the articles. Yose Rizal and Zurmiati participated in the investigation, writing the original draft, and writing and editing the article. Sepri Reski was responsible for data curation, methodology, and investigation. Elsanila Suryadi Buwono and Kamiliya Rahma Sari participated in formal analysis and investigation. The article was written collaboratively by all authors, who reviewed the statistical analyses and endorsed the final version for publication.

CONFLICT OF INTEREST

No conflicts of interest are related to the work reported in this article.

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