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Effect of Substituting Soybean Meal with Fermented Leaves and Seeds of the Rubber Tree (*Havea brasiliensis*) on Protein Intake and Percentage of Organ Weight in Broiler Chicken

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Abstract

Objective: This study aimed to determine the protein intake and percentage of organ weight in broilers fed rations containing fermented leaves and seeds from the rubber tree (FLSRT) as a substitute for soybean meal. The results of this study are also expected to reduce the use of imported feed ingredients and feed ingredients that compete with human needs, such as soybean meal.

Methodology: This research consisted of an experiment in the field/cage that lasted 8 weeks and used 480 broilers of the AA CP 707 strain. The chickens were kept in a battery cage made of wire. Each cage unit was equipped with a feed container, a drinking area and an incandescent lamp. A complete randomized design with 6 treatments and 4 replications was used. The data obtained were analyzed with ANOVA. Differences between treatments were tested by Duncan's Multiple Range Test (DMRT). The treatments were a control ration and the replacement of soybean meal with selected proportions of fermented rubber leaves and seeds (0, 20, 40, 60, 80 and 100%). The observed variables were protein intake and percentage of organ weight in broilers.

Results: Broiler chicken production, especially protein intake and the percentage of internal organ weight, was not greatly influenced by the use of FLRST in the livestock feed.

Conclusion: Soybean meal protein can be replaced with FLRST at a proportion of up to 80% in broiler chicken rations.

Keywords: Rubber Leaves and Seeds; Fermentation; Protein Intake; Internal Organs; Broiler Chickens

Introduction

In intensive poultry farming, nutritional needs must be provided by farmers. In this system, feed is the largest component of production costs. In the broiler business, the cost of feed is 70% of the variable costs (Nurtini, 1988) [1], and the cost of feed for ducks is 60% of the variable costs (Anggorodi, 1995) [2]. High feed prices are a cause of losses in poultry farming in Indonesia. One of the causes of the high price of poultry feed is the high price of feed raw materials, especially imported ones such as fish meal, soybean meal and corn.

Soybean meal is a vegetable protein ingredient for poultry rations that contains higher protein and more complete amino acids than do other vegetable feed ingredients; on the other hand, its availability is sometimes limited. However, the need for raw materials such as soybean meal always increases with the development of poultry farming. The need for soybean meal is nearly, almost 100%, fulfilled by imports, which was approximately 1,458,000 tons in 2017 (HKTI, 2018) [3]. To reduce dependence on imported feed ingredients such as soybean meal, efforts are needed to find raw materials to replace soybean meal as alternative feed ingredients. One of raw material that is not widely used is the leaves and seeds of rubber plants (*Havea brasiliensis*); these plants are highly adaptable and can grow at an altitude of 0 to 1500 meters. Rubber plants (*Havea brasiliensis*) are a plantation crop. According to the Central Bureau of Statistics (2018) [4], the area of rubber plantations in Indonesia is 5,875,600 ha, making Indonesia the largest rubber producer in the world. Every 1 hectare of rubber plantation is planted with 400-500 trees.

The low nutrient content and the presence of anti-nutrient substances result in the use of rubber tree in rations not being maximized. The results of an analysis of rubber leaves and seeds showed a crude protein content of 15.70-18.62%, a crude fat content of 10.89%, metabolic energy of 1762.95 - 2301.64, nitrogen retention of 53.42 - 71.19 and a fiber content of approximately 15.73 - 18.62 (Syahruddin and Rita., 2010) [5]. According to Oluyemi *et al.* (1976) [6], the metabolic energy of leaves and rubber seeds is approximately 4,835 Kcal/kg, and rubber leaves and seeds also contain various amino acids, such as aspartic acid, glutamic acid, lysine, arginine, methionine and threonine, which represent 10.25, 14.73, 2.55, 7.23, 0.92 and 2.65% of the total protein content

(Orok and Bowland., 1974) [7]. The main obstacle to the use of rubber leaves and seeds as animal feed is the high levels of cyanide acid (HCN). According to Law *et al.* (1967) [8], the HCN content of fresh rubber leaves and seeds is 263 mg/100 gr. According to Syahruddin and Rita (2009) [9], the HCN content of rubber leaves and seeds can be reduced or eliminated by storage, extraction, drying, soaking in water or boiling, and when the leaves and seeds of rubber tree are soaked for 24 hours, HCN levels are decreased; moreover, according to Toh and Chia (1977) [10], boiling rubber leaves and seeds at 160 °C can eliminate HCN toxins. The results of the study by Syahruddin and Rita., (2010) [5] showed that fresh rubber leaves and seeds given in broiler chicken rations in excess of 9% of the ration could reduce weight gain and ration consumption. To address this effect, rubber leaves and seeds need to be processed so that the quality can be improved. The method that can be used is the fermentation of rubber leaves with microbes (Trichoderma is able to increase the percentage of crude protein to 23.98%).

Protein consumption is the consumption of organic substances containing carbon, hydrogen, nitrogen sulfur and phosphorus (Anggorodi, 1995) [2]. According to Wahju (1997) [11], the level of ration consumption depends on the protein content of the ration. Gultom (2014) [12] states that high protein consumption will also affect protein levels in meat and allow for sufficient amino acids in the body so that the metabolism of cells in the body can occur normally.

This is consistent with the opinion of Tampubolon and Bintang (2012) [13], who stated that protein intake is influenced by ration consumption. The more that is energy contained in feed, the less the feed is consumed and vice versa; if the energy of the feed is low, more feed will be consumed to meet their needs. According to Amrullah (2004) [14], when approaching harvest time, excess energy is provided so that the chickens can store excess fat solids in the subcutaneous and abdominal tissues in the body.

Considering the productivity and potential benefits of rubber plants as an export material, the use of rubber leaves and seeds as poultry feed ingredients also needs to be examined. According to the data above, rubber leaves and seeds have great potential to be used to replace soybean meal in animal feed.

Research Methods

Research Material

This experiment was carried out for 8 weeks using 480 DOC strain Cobb broilers. The chicks were kept in a colony cage made of wire. Each unit enclosure was equipped with a dining area, a place to drink and an incandescent lamp.

The feed ingredients used to prepare the ration consisted of the following: leaf flour and rubber seeds that were fermented with *Trichoderma spiralis*; soybean meal; fish meal; yellow corn; fine bran; bone meal; and premix A. The substance content of these food materials were first analyzed by a proximate method, and the rations contained the same protein levels and calories.

The composition of the treatment ration for livestock is shown in Table 1, and the food and metabolic energy content in the ration is shown in Table 2.

Ingredient	Percentage					
	RO	Rl	R2	R3	R4	R5
Corn	50	49.13	48.26	47.39	46.52	45.65
Soybean meal	20	16	12	8	4	0
FLSRT	0.0	5.87	11.74	17.61	23.48	29.35
Fine rice bran	15.5	14.5	13.5	12.5	11.5	10.5
Fish meal	6.0	6	6	6	6	6
Bone meal	1.5	1.5	1.5	1.5	1.5	1.5
Flour shells	4.0	4.0	4.0	4.0	4.0	4.0
Coconut oil	2.5	2.5	2.5	2.5	2.5	2.5
Top mix	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100

Table 1: Composition of the ration

Components	R0	R1	R2	R3	R4	R5
Crude protein (%)	21.680	21.590	21.490	21.400	21.310	21.210
Fat (%)	3.910	3.900	3.890	3.880	3.870	3.860
Crude fiber (%)	4.780	5.170	5.560	5.950	6.340	6.730
Ca (%)	1.230	1.210	1.290	1.220	1.200	1.180
Total P (%)	0.680	0.690	0.700	0.710	0.720	0.730
ME (kcal kg G^1)	2942.800	2940.300	2937.800	2935.300	2932.800	2930.300

Components	R0	R1	R2	R3	R4	R5
Methionine (%)	0.296	0.295	0.293	0.291	0.290	0.289
Lysine (%)	1.110	1.053	0.990	0.930	0.870	0.820
Results of the calculations						

Table 2: Nutritional and metabolic energy contents of the experimental rations

Research methods

The experiment that administered rations to poultry was carried out according to a completely randomized design with 6 treatments and 4 replications.

The treatment groups were as follows:

R0 replaced 0% FLRST control ration or without soybean meal replacement;

RI replaced 20% soybean meal protein with FLRST;

R2 replaced 40% soybean meal protein with FLRST;

R3 replaced 60% soybean meal protein with FLRST;

R4 replaced 80% soybean meal protein with FLRST; and

R5 replaced 100% soybean meal protein with FLRST.

Processing and analysis of data

All data were analyzed using one-way analysis of variance (ANOVA) of the completely randomized design as described by Steel and Torrie (2012) [15]. The differences among treatments were tested with Duncan's multiple range test (DMRT), with a significance level of P<0.01.

Observed parameters

The parameters observed included the average ration consumption, protein consumption, lean protein mass, protein efficiency ratio, average percentage of heart weight, percentage of gizzard weight, percentage of heart weight and percentage of broiler chicken kidney weight.

Results and Discussion

Effect of Treatment on Ration Consumption, Protein Consumption, Meat Protein Mass and Protein Efficiency Ratio of Broilers.

Experiments were performed on 480 broilers aged 1

Day and provided a ration for 8 weeks. The average ration consumption, protein consumption, lean protein mass and protein efficiency ratio per individual per week during the study are shown in Table 3.

Treatment	Ration Consumption (g/individual/week)	Protein Consumption	Meat Protein Mass	Protein Efficiency Ratio
RO	563.40^{a}	126.69^{a}	67.37^{a}	2.73^{a}
R1	569.43^{a}	126.78^{a}	67.58^{a}	2.76^{a}
R2	573.72^{a}	127.01^{a}	68.51^{a}	2.81^{a}
R3	576.12^{a}	127.12^{a}	68.63^{a}	2.85^{a}
R4	578.12^{a}	127.53	68.95^{a}	2.92^{a}
R5	529.96^{b}	121.64^{b}	59.49^{b}	2.51^{b}
Average	565.12	126.13	66.75	2.76

Note: $^{a, b}$different superscript values in the same column show very significant effects (P <0.01); SE: 0.61

Table 3: Average Ration Consumption, Protein Consumption, Meat Protein Mass and Protein Efficiency Ratio of Broilers per Individual per Week

The analysis of variance results showed that the replacement of soybean meal protein with FLRST protein up to 100% in broiler chicken rations significantly impacted (P <0.01) the ration consumption, protein consumption, meat protein mass and protein efficiency ratio of broiler chickens.

Table 3 shows that the consumption of rations with different FLRST levels observed during the study ranged from 529.96-578.12 g/individual/week or from 80.05 to 81.87 g/individual/day. The average ration consumption in this study was lower than that reported by Blakely and Bade (1991) [16] (90-100 g/individual/day) and by Gunawan and Cresswell (1982) [17] (88 g/individual/day). According to Khodijah *et al*. (1992) [18], the consumption of 25-70 week-old broiler chickens is 115 g/individual/day.

The differences in the ration consumption caused by FLRST may be due to the proper processing of FLRST to improve quality and to yeild the same palatability as soybean meal; consequently, the use of FLRST up to 23.48% in broiler chicken rations instead of 80% soybean meal had no effect on ration consumption. In addition, the difference in the consumption of food was also caused by the metabolic energy content, protein and other food substances, which were also the same in each treatment.

Effect of Treatment on Protein Consumption

Based on Table 3, the average protein consumption of broiler chickens treated with FLRST for 8 weeks ranged from 121.64 - 127.53 g/individual/week, not much different from that reported by Irawati (2012) [19], who found that protein consumption for 35 days remained between 19.10 - 20.79 g/individual/day. Based on the diversity analysis, the use of FLRST in rations up to the 100% level had a very significant effect ($P < 0.01$) on the protein consumption of broiler chickens. The statistical results (Duncan's multiple new range test) showed that the protein consumption of the R0 treatment was not significantly different ($P > 0.05$) from that of the R1, R2, R3 and R4 treatments, but it was very significantly different ($P < 0.01$) from the R5 treatment. The protein consumption of treatment R2 was not significantly different ($P > 0.05$) from that of treatments R3 and R4 but was significantly different ($P < 0.01$) from that of treatment R5. The protein consumption of the R4 treatment was significantly different ($P < 0.01$) from that of the R5 treatment.

The protein consumption of the R5 treatment was lower than that of the R0, R1, R2, R3 and R4 treatments; this was caused by the different ration consumption of the R5 treatment ($P < 0.01$). In other words, giving FLRST at up to a 100% level in the ration very significantly impacts the average consumption of rations, so that protein consumption is also markedly impacted. Parakkasi (1990) [20] stated that poultry will consume protein along with the quantity of ration consumed. This is consistent with the opinion of Tampubolon and Bintang (2012) [13], who stated that protein consumption is influenced by the level of ration consumption. According to Winedar *et al*. (2004) [21], the higher the protein content of the ration is, the higher the protein consumption; however, if the protein content is relatively the same, the protein consumption will be the same.

The average protein consumption of broiler chickens from the third week to the eighth week in this study was 121.64 - 127.53 g/individual/week. The average protein consumption in this study was lower than that reported in the study by Situmorang *et al*. (2013) [22] (143.20 - 155.34 g/individual/week), which investigated the effect of granting seaweed flour (*Gracilaria verrucosa*) in rations on the efficient use of broiler chicken protein. This difference is due to the higher consumption of rations in the previous study than in this study. High ration consumption causes high protein consumption because the rations are iso-protein and iso-energy. This is consistent with Wahju's (1997) [11] opinion that the amount of ration consumption reflects the amount of protein consumed. Rasyaf (2000) [23] added that the amount of feed consumed by chickens depends on species, age, body weight, environmental temperature and the nutrient level of the feed. It can also be seen that protein consumption decreases with increasing levels of FLRST administration. This is because FLRST contains HCN that decreases the palatability or taste of food that contains FLRST, which has a more bitter taste than the control ration or rations without FLRST. Scott *et al*. (1982) [24] stated that one factor that can increase feed consumption is feed palatability. However, the protein consumption found in this study was higher than that found by Bell and Weaver (2002) [25] (23.10 - 83.51 g/individual/week), who evaluated the balanced protein efficiency of broiler chicken rations containing chicken feather flour fermented with Bacillus spp. and Lactobacillus spp. This level was much different from what was reported by Irawati (2012) [19], who found that the consumption of protein over 35 days remained between 19.10 - 20.79 g/individual/day. Furthermore, Wahju (1997) [11] reported that for normal growth, broilers can consume protein 120.11 gr/week or 17.15 gr/day.

Effect of Treatment on Meat Protein Mass

The average protein mass of broiler chicken meat from each treatment group is shown in Table 3.

Based on Table 3, the average protein mass of broiler chicken meat treated with FLRST for eight weeks ranged from 59.49 - 68.95 g/individual/week. Based on diversity analysis, the use of FLRST in rations up to the 100% level had a very significant effect ($P < 0.01$) on the protein mass of broiler chicken meat. The results of DMRT (Duncan's multiple new range test) showed that the consumption of protein was not significantly different ($P > 0.05$) between the R0 treatment and the R1, R2, R3 and R4 treatments, but it was very significantly different ($P < 0.01$) different from the R5 treatment. Feeding with a highly diverse source of protein results in a lower protein mass of meat. This relates to the consumption of protein and amino acids; the consumption of insufficient amino acids will certainly result in low levels of meat protein. Adnyana *et al*. (2014) [26] found that amino acids are the main ingredients involved in the process of meat formation. Fanani *et al*. (2016) [27] stated that meat protein mass is the level of protein deposition in livestock bodies.

The low mass of meat protein is influenced by the level of meat protein, the weight of the meat produced and the level of fat in the body; this means that the carcass produced is of good quality. A good carcass contains a large amount of meat and little fat. Griffith *et al*. (1998) [28] stated that body fat is positively correlated with carcass fat; if body fat is low, then carcass fat is also low.

Meat protein mass shows the level of protein deposition in the body; high protein consumption is associated with high protein intake, which means that more protein is deposited into meat. Protein deposition is the amount of protein absorbed minus the protein utilized by the body, where the rate of protein deposition is influenced by the availability of protein and energy in the feed; energy plays a role in the process of protein synthesis. Suthama (2010) [29] stated that protein and energy have a very important role in the process of protein synthesis.

The average protein mass of broiler chicken meat from the third week to the eighth week in this study was 59.49 - 68.95 g/individual/week. The average protein mass of meat in this study was lower than that reported by Ensminger *et al.* (1992) [30], who investigated the effect of feeding with different protein sources on the percentage of carcass cuts and protein mass of local crossbred chicken meat and reported a value equal to 70.25 - 100.92 g/individual/week. The value found in the current study was also lower than the meat protein mass results found in research by Mirnawati *et al.* (2013) [31], who reported that the mass of meat protein in broiler chickens maintained for 8 weeks with a 22.01% protein content in rations was 69.99 g/individual/week. However, the results of this study were higher than the mass of meat protein reported by the research by Abbdurrahman *et al.* (2016) [32], namely, the mass of meat protein was 62.91 g/individual/week. The mass of meat protein decreased with decreasing protein content in the ration.

Effect of Treatment on Protein Efficiency Ratio

The average protein efficiency ratio of broiler chickens in each treatment group is shown in Table 3.

Based on Table 3, the average protein efficiency ratio of broiler chickens treated with FLRST for eight weeks ranged from 2.51 - 2.92. The analysis of diversity shows that the use of FLRST in rations up to the 100% level had a very significant effect (P <0.01) on the ratio of protein efficiency of broilers. The results of DMRT (Duncan's multiple new range test) showed that the protein efficiency ratio of the R0 treatment was not significantly different (P> 0.05) from that of the R1, R2, R3 and R4 treatments but was very significantly different (P <0.01) from that of the Q5 treatment. The protein efficiency ratio of the R1 treatment was not significantly different (P> 0.05) from that of the R2, R3 and R4 treatments but was significantly different (P <0.01) from that of the R5 treatment. The protein efficiency ratio of the R2 treatment was very significantly different (P <0.01) from that of the R5 treatment.

The difference in the protein efficiency ratio of the R0, R1, R2, R3, and R4 treatments and that of the R5 treatment was influenced by protein consumption and body weight gain. The ratio of protein efficiency is obtained by comparing body weight gain to protein consumption. Piliang and Al Haj (1991) [33] stated that the use of protein or the protein efficiency ratio (REP) is the increase in body weight (grams) per amount of protein consumed (grams), and Wahju (1997) [11] also explained the ratio of protein efficiency as the ratio of body weight gain and the amount of protein consumed.

The average efficiency ratio of broiler chicken protein from the third week to the eighth week in this study was 2.51 - 2.92. The ratio of protein efficiency in this study was higher than that of the study of Siregar (2001) [34] that investigated the effect of feeding different protein sources on the efficient use of cross-linking local chicken protein, which was equal to 1.40 - 1.62. This differences was caused by the body weight gain and protein consumption of the chickens, when the body weight gain and protein consumption of broiler chickens is increased, then smaller feed conversion rate is observed. As noted by Kompiang *et al.* (1994) [35], the ratio of protein efficiency reflects the use of protein for growth and is obtained from a comparison of body weight gain and ration consumption. The higher the value of the protein efficiency, the more efficiently the animals use the protein consumed (Anggorodi, 1995) [2]. Males have a higher body weight gain than females, so the ratio of protein efficiency is higher in males than in females. The protein efficiency ratio of this study was also higher than that reported by Martua (2010) [36], in which the ratio of protein efficiency in broilers fed commercial and probiotic rations was approximately 2.20 - 2.38, while it was lower than the protein 2.93 efficiency ratio of broiler chickens given commercial rations in Irawati (2012) [19].

Factors that influence the ratio of protein efficiency are weight gain and protein consumption. This is in accordance with the opinion of Liu *et al.* (2015) [37], who stated that protein efficiency is influenced by protein consumption. Fanani *et al.* (2016) [27] added that the factors that influence the ratio of protein efficiency include body weight gain, protein consumption, age and temperature. The protein efficiency ratio is very important in raising chickens and is related to the price of protein sources in feed ingredients. Arita (1986) [38] stated that protein sources are very important ingredients in feed but have relatively expensive prices.

Samadi (2012) [39] added that protein efficiency is not only related to the cost of expensive protein source feed ingredients but also related to the pollution caused by livestock such as nitrogen. The low protein efficiency ratio reported by Aritonang (1986) [40] was due to the excessive consumption of protein, which was converted to energy.

Effect of Treatment on the Percentage of Heart Weight, Percentage of Gizzard Weight, Percentage of Heart Weight and Percentage of Broiler Chicken Kidney Weight

The average percentage of liver weight, percentage of gizzard weight, percentage of heart weight and percentage of kidney weight of broilers given ration containing rubber tree leaves and processed seeds (FLRST) as a substitute for soybean meal protein are shown in Table 4. In Table 4, it appears that the percentage of liver weight ranges between 2.40 and 2.96% per individual, the percentage of gizzard weight ranged from 2.19 to 2.24%, the percentage of heart weight ranged from 0.61 to 0.79, and the percentage of kidney weight of broilers ranged from 0.23 to 0.35.

The variance analysis results showed that the replacement of soybean meal protein with processed rubber leaves and seeds at up to 80% of the broiler ration had a significant effect (P> 0.05) on the percentage of heart weight and the percentage of broiler chicken kidney weight, but it a very significant effect (P <0.01) was observed at 100% FLRST.

Percentage of Heart Weight: Data describing the percentage of liver weight of chickens treated with fermented rubber (*Havea brasiliensis*) leaves and seeds (FLRST) are shown in Table 4.

Treatment	Liver Weight (%)	Gizzard Weight (%)	Heart Weight (%)	Kidney Weight (%)
RO	2.40[a]	2.19[a]	0.61[a]	0.23[a]
R1	2.43[a]	2.20[a]	0.63[a]	0.24[a]
R2	2.45[a]	2.20[a]	0.64[a]	0.24[a]
R3	2.49[a]	2.21[a]	0.64[a]	0.25[a]
R4	2.52[a]	2.23[a]	0.65[a]	0.25[a]
R5	2.96[b]	2.24[a]	0.79[b]	0.35[b]
Average	2.54	2.21	0.66	0.26

Note: [a,b]different superscript values in the same column represent a significant effect (P <0.01); SE: 0.61
Table 4: The Average Effect of Treatment on the Percentage of Liver Weight (%), Percentage of Gizzard Weight (%), Percentage of Heart Weight (%) and Percentage of Kidney Weight (%) of Broilers During the Research

The analysis of variance results showed that the ration treatments had a very significant effect (P <0.01) on the percentage of liver weight (Table 4). The percentage of liver weight of chickens was not significantly affected by the R0, R1, R2, R3, and R4 treatments containing rubber seed flour (P> 0.05), but the R5 treatment (100%) of rubber seed flour had a very significant effect (P <0.01). The percentage of liver weight in this study was 2.40% -2.96% of the live weight. This result was higher than the result reported by Giok *et al*. (1967) [41], who used 42-day-old broiler chickens and obtained 2.04% -2.56%, and that of Putnam (1991) [42], who obtained a liver percentage of 1.70% -2.80% of live weight.

Table 4 shows that the higher percentage of rubber seed flour given in the ration yielded a higher percentage of liver weight; the high percentage of liver weight in this study was probably due to the presence of the cyanide acid anti-nutrient contained in the rubber seeds added to the ration, which affects the function of the liver in detoxifying substances and reducing swelling. According to the opinion of Ressang (1984) [43], one of the functions of the liver is detoxification of toxins, and an abnormality is indicated by the enlargement or reduction of the liver.

The liver weights observed in this study ranged from 58.27 to 61.51 grams of live weight, and these results were higher than those reported by Lubis *et al*. (2007) [44], who obtained liver weights of 32.58-35.57 grams. This difference in results is likely due to differences in the age of the studied chickens. Lubis used 42-day-old chickens, while in this study; 49-day-old chickens were used. In accordance with the statement of Mc Lelland (1990) [45], the factors that influence liver weight are body weight, species, sex, age, and pathogenic bacteria.

Percentage of Gizzard Weight: TPercentage of Gizzard Weight: Data on the percentage of gizzard weight of broiler chickens treated with fermented rubber leaves and seeds (FLRST) are shown in Table 4.

The results of the diversity analysis showed that the FLRST treatment had no significant effect (P> 0.05) on the percentage of gizzard weight, indicating that the use of 29.35% FLRST with a crude fiber content of 6.73% can still be tolerated by the gizzard. In accordance with Febriyenti's (2001) [46] research on the use of ATF (fermented tofu dregs), 25% ATF with a crude fiber content of 7.23% can still be tolerated by the gizzard. The results of this study are also in accordance with Putnam (1991) [42], who stated that the percentage of gizzard weight is 1.6% -2.3% of the body weight.

Percentage of Heart Weight: Based on analysis of variance, the addition of rubber seed flour in the experimental ration had a very significant effect (P <0.01) on the percentage of heart weight (Table 4). The percentage of heart weight of chicken administered the R0, R1, R2, R3 and R4 (80%) treatments containing rubber seed flour had no significant effect (P> 0.05) on the percentage of heart weight, but treatment with the ration containing 100% rubber seed flour had a very significant effect (P <0.01). The percentage of heart weight ranged between 0.61% - 0.79% of the body weight of chickens. This value was higher than that reported in research conducted by Noormasari (2000) [41], who obtained 0.49% -0.60%, and in research by Dewi (2007) [47], who provided a commercial ration and obtained a percentage of heart weight of 0.50% -0.57% of the body weight. Putnam (1991) [42] stated that the normal percentage of heart weight in broiler chickens ranged from 0.42% -0.70% of live weight. The difference that occurred is thought to be due to differences in the chicken activity in each treatment group, in accordance with the statement of Ressang (1984) [43]; the size of the heart is strongly influenced by age, size, and animal activity.

The high percentage of heart weight in the study was probably caused by the content of cyanide acid contained in the rubber seeds that were continuously given in the ration, resulting in the accumulation of the cyanide acid in the heart muscle, affecting the function of the heart and resulting in an enlarged heart. In accordance with the statement by Fransdson (1992) [48], the heart is very susceptible to toxins and anti-nutrients, and heart enlargement can occur due to the accumulation of toxins in the heart muscle. The heart functions as a pump and motor to drive blood circulation and works in an autonomous way that is controlled by the central nervous system without will and awareness. Heart size depends on sex, age, body weight, and animal activity. An enlarged heart size is usually caused by the addition of muscle tissue to the heart (Ressang, 1984) [43].

Percentage of Kidney Weight: The kidney is an organ that filters plasma from the blood and selectively reabsorbs water and useful elements that return from phytates, which ultimately release excess and plasma waste products (Frandson, 1992) [48]. The provision of rubber seed flour in the ration at a level of 80% did not statistically affect the percentage of broiler chicken kidney weights (Table 4). The percentage of kidney weight ranged from 0.23% -0.35% of the body weight. This percentage is higher than that reported in research by Lubis *et al.* (2007) [44], who added fermented cassava at a level of 15% and obtained a kidney weight percentage of 0.22% -0.29% of the live weight. The high percentage of broiler chicken kidney weights found in this study may be due to the age of the broiler chickens in this study, which was 7 days older than the age of the chickens in research performed by Lubis *et al.* (2007) [44].

The kidneys play a role in maintaining the balance of the blood structure by removing substances such as excess water, organic salts, and other substances that are dissolved in the blood (Ressang, 1984) [43]. Suprijatna *et al.* (2008) [49] stated that the main function of the kidneys is to produce urine through blood filtration so that water and metabolic waste are secreted. The next process that occurs is the reabsorption of some nutrients (for example, glucose and electrolytes), which are then used by the body.

Conclusion

The production performance of broilers, especially the average consumption of ration, protein consumption, protein mass, protein efficiency ratio, average percentage of liver weight, percentage of weights, percentage of heart weight and percentage of kidney weight of broiler chickens, was not greatly influenced by the use of fermented rubber leaves and seeds (FLRST) at up to 80% of livestock rations. The rate of replacement of soybean meal protein with rubber leaves and seeds fermented using *Trichoderma spiralis* molds can be up to 80% in broiler chicken rations.

Significance Statement

This study found that in order to improve the quality of broilers, substituting rubber leaves and seeds processed by microbes for soybean meal (imported commodities) can be beneficial as a feed ingredient in the preparation of chicken rations.

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References

1. Nurtini S (1988) Business Overview and Prospects of Laying Chicken Farms. Paper at the Poultry and Livestock Seminar II. Balitnak-Bogor, Indonesia.

2. Anggorodi R (1995) Recent Advances in Poultry Feed Science. Universitas Indonesia Press, Jakarta, Indonesia.

3. Association of Indonesian Farmers Groups (2018) Volume and Value of several Kompas Daily commodities.

4. Bureau of Statistics (2018) Estate Crop Production Index. Indonesian Statistics, Indonesia.

5. Syahruddin E, Rita H (2010) Provision of fresh rubber leaves on Broiler Chicken Performance. Faculty of Animal Husbandry Research Report, Indonesia.

6. Oluyemi JA, dan FA Roberts (1976) Poultry Production in Warm Wet Climates. Macmillan, London.

7. Orok EJ, Bowland JP (1974) Prospect for the use of rubber seed meal for feeding pigs and poultry. In Feedingstuff for livestock in Southeast AsiaMalaysian Society of Animal Production 1974: 337-44.

8. Lauw TG, Samsudin MD, Husaini BS, Tarwotjo I (1967) Nutritional Value of Rubber - Seed Protein. Am J Clin Nutr 20: 1300-13.

9. Syahruddin E, Rita H (2009) Provision of rubber leaves fermented with Neurosphora sitophila against Broiler Chicken Performance. Faculty of Anim Husbandry Res Rep.

10. Toh KS, Chia SK (1977) Nutritional value of rubber seed meal in live stock in Southeast Asia. In Feedingstuff for livestock in Southeast Asia. Malaysian Society of Animal Production 1977: 345-51.

11. Wahju J (1997) Poultry Nutrition Science. Gajah Mada University Press. Faculty of Animal Science IPB, Bogor, Indonesia.

12. Gultom SM, Supratman RDH, Abun (2014) The Effect of Energy and Protein Balance on Feed Carcass Weight and Abdominal Fat Weight of Broiler Chicken 3-5 Years Old. Journal of the Faculty of Animal Husbandry, Padjadjaran University, Bandung, Indonesia.

13. Tampubolon, Bintang P (2012) Effect of Energy Balance and Protein Ration on Metabolic Energy and Nitrogen Retention of Broilers. Journal of the Faculty of Animal Husbandry, Padjadjaran University, Bandung, Indonesia.

14. Amrulah IK (2004) Broiler Chicken Nutrients. Satu Gunung Budi Institute, Bogor, Indonesia.

15. Steel RGD, Toorrie JFI (2012) Principles and procedure of Statistics, Second Ed. Mc Grow Hill International Book Company, Singapore.

16. Blakely D, Bade DH (1991) Animal Husbandry. 4th edition. Translator: Bambang Srigandono. Gadjah Mada University Press, Yogyakarta, Indonesia.

17. Gunawan, Sundari MMS (2003) Effect of the use of probiotics in rations on chicken productivity. Wartazoa 13: 92-8.

18. Khodijah S, Abun Wiradimadja R (2012) Balance of Protein Efficiency that was given the ration Contains Extracts of Jengkol (Pithecellobium jiringa (Jack) Prain). Journal of Padjadjaran University 1.

19. Irawati P (2012) Efficient Use of Broiler Chickens Protein Given with Fermented Palm Oil Creme Using Trichoderma harzianum and Probiotics. Thesis, Faculty of Animal Husbandry, University of Jambi, Indonesia.

20. Parakkasi A (1990) Nutrition and Monogastric Animal Feed. First printing, Space, Bandung, Indonesia.

21. Winedar H, Listyanti S, Sutarno (2004) Digestibility of Feed Protein, Protein Content of Meat, and Weight Increase of Broilers After Feeding Fermented Fermented Foods with Effective Microorganisms (EM-4). Biotechnology 3: 14-9.

22. Situmorang NA, Mahfudz LD, Atmomarsono U (2013) The Effect of Seaweed (Gracilaria verrucosa) flour in ration on the Efficient Use of Broiler.

23. Rasyaf M (1994) Broiler Chicken Food, Yogyakarta, Indonesia 1994: 120-2.

24. Scott ML, Nesheim MC, Young RJ (1982) Nutrition of Chicken (3rd edn) Ithaca, NewYork, USA.

25. Bell DD, Weaver WD (2002) Commercial Chicken Meat and Egg Production (5th Edn) Springer Science + Business Media, Inc. Spiring Street, New York.

26. Adnyana IGS, Dewi GAMK, Wirapartha M (2014) Effect of energy and protein balance on female chicken carcasses aged 30 weeks. J Tropic Anim Sci 2: 415-23.

27. Fanani AF, Suthama N, Sukamto B (2016) The effect of adding dahlia flower bulbs as a source of inulin on protein digestibility and productivity of local crossbred chickens. J. Veterinary Medicine 10: 58-62.

28. Griffiths L, Leeson S, Summers JD (1998) Studies and abdominal fat with four commercial strains of male broiler chicken. J Poult Sci 53: 1198-203.

29. Suthama N, Wahyuni HI, Mangitsah I (2010) Growth rates based on the degradation of the body's protein in kedu chickens are maintained ex situ. Proceedings of the 4th National Seminar on Local Poultry. Faculty of Animal Husbandry, Diponegoro University, Semarang. Thing. 138 - 146.Chicken Protein. Animal Agricultural Journal 2: 49-56.

30. Ensminger ME, Oldfield JE, Heinemer WW (1992) Feeds Nutrition Co, California, USA.

31. Mirnawati , Sukamto B, Yunianto VD (2013) Protein digestion, nitrogen retention and protein mass of broiler chickens meat fed on mulberry leaf ration (Morus alba l.) Fermented with rumen fluid. Journal of Animal and Veterinary Sciences 3: 25-32.

32. Abdurrahman ZH, Pramono YB, Suthama N (2016) Feeding effect of inulin derived from dahlia tuber combined with lactobaccilus. sp on meat protein mass of crossbred kampong chicken. J Indonesian Trop Anim Agric 41: 37-44.

33. Piliang WG, Al Haj Djojosoebagjo S (1991) First Volume Nutrition Physiology. Ministry of Education and Culture Directorate General of Higher Education Inter-University Center for Life Sciences IPB, Bogor, Indonesia.

34. Siregar B (2001) Effect of replacing coconut cake with palm kernel cake on the performance of quail (Coturnix-coturnix Japonica). J Livest and Environ 07: 6-11.

35. Kompiang JP, Darma J, Purwadaria T, Sinurat AP, Supriyati K (1994) Protein enrichment: Cassava Studies Enrichment through Biological Processes for monogastric animals. Annual report, Balitnak Cooperation, Indonesia.

36. Martua GN (2010) Use of Bacillus and Lactic Acid Bacteria to Increase Protein Efficiency Ratio and Reduce Ammonia Enclosure. Faculty of Animal Husbandry, University of Jambi. Jambi, Indonesia.

37. Liu SK, Niu ZY, Wang YN, Zhang J, Haf ZF, et al. (2015) Effect of dietary crude protein on the growth performance, carcass characteristics and serum biochemical indexes of lueyang black boned chicken from seven to twelve weeks of age. Jurnal Brazilian Poultry Science 17: 105-8.

38. Arita D (1986) Possible Utilization of Rubber Seed in Potions Feed. Journal of Research and Development Ranch 5: 72-8.

39. Samadi (2012) The ideal concept of protein (amino acids) focus on broilers. Agripet Journal 12: 42-8.

40. Aritonang D (1986) Possible utilization of rubber seed in livestock feed. J Livest Res Dev 5: 72-8.

41. Giok LT, Samsudin, Husaini, Tarwotjo I (1967) Nutritional value of rubber-seed protein. Paediatr Indones 20: 147-50.

42. Putnam PA (1991) Animal Breeds, Handbook of Animal Science. Academy Press, San Diego, USA.

43. Ressang AA (1984) Veterinary Special Pathology (2nd Edn) CV Printing Bali, Denpasar, Indonesia .

44. Lubis AD, Suhartono B, Darmawan H, Ningrum IY, Noormasari IK, et al. (2007) Evaluation of fermented cassava (Manihot esculenta Crantz) pulp as feed ingredient for broiler. Journal of Tropics 17: 73-80.

45 . Mc Lelland J (1990) A Color Atlas of Avian Anatomy. Wolfe Publishing Limited, England.

46. Febriyenti (2001) Effect of Sago Dregs Fermented with Rhizosphora sp on Broiler ChickenDigestion Organs. Andalas University, Padang, Indonesia.

47. Dewi HRK (2007) Evaluation of several commercial rations on the percentage of carcass weight, abdominal fat, and organs in broiler chickens. Faculty of Animal Husbandry Bogor Agricultural University, Bogor, Indonesia.

48. Frandson RD (1992) Animal Anatomy and Physiology (4th Edn) Gadjah Mada University Press, Yogyakarta, Indonesia.

49. Suprijatna E, Atmomarsono U, Kartasudjana R (2008) Basic Science of Poultry (2nd printing) Penebar Swadaya, Jakarta, Indonesia.